THE

ELECTRICAL REVIEW.

VOL. XL. JANUARY 29, 1897. No. 1,001.

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1,001.

TOWARDS the end of 1896 the *Scientific American* celebrated the fiftieth year of its existence, and devoted a series of articles to the progress which had been made during that period in all branches of technical industry. The first number to hand of the New York *Electrical Engineer* for the new year is consecrated to a like purpose, still our estimable, vigorous, but youthful contemporary can only celebrate its fifteenth year. Probably but few of our readers noticed that last week's issue of the ELECTRICAL REVIEW bore the significant number of 1,000, so that this issue, therefore, is the first number of the second thousand. Commenced on November 15th, 1872, as a monthly journal, when no other electrical paper now appearing was in existence, it developed in June, 1873, into a bi-monthly production, and in January, 1882, was begun its present weekly publication.

By dint of hard work, and by always primarily considering our readers' interests, the REVIEW has obtained and held a position which is too well known for us to enlarge upon. The same line of conduct will be ours in future, and we trust with a like unvarying success.

Our above quoted electrical contemporary, in an article entitled "Fifteen Years Aspect of Technical Journalism," makes an allusion to American methods which is very significant. "The greater diversity of electrical interests has rendered the technical press more independent; there is less editing by advertisers, and therefore the well considered criticisms of technical papers are becoming more valuable." We are fain to believe that the practice of editing in the manner here indicated does not obtain in this country amongst the Electrical Press; at all events our worst enemy could not accuse the REVIEW of thus sinking its independence for the sake of extra business.

The recent marvellous advances in what may be termed the physical department of electro-technics, provide reading matter for the professional man and the cultured amateur as fascinating and wonderful as did those entrancing "thousand and one night's" stories for our youthful days, since the supposed powers of the magician are outdone to-day by the results of the researches of the physicist, and the reality of such marvels, to take only two, of Marconi's telegraphy over considerable distances by means of Hertzian waves, and Röntgen's discovery of what are still termed X rays, are as remarkable as many of the magical deeds attributed to the professors of the black art in that well-beloved book of our youth, the "Arabian Nights." The equally rapid developments in the domain of electric lighting, electrical transmission of power, traction, &c., form matter of just as much importance to the practical engineer and commercial man, and, as our contemporary very concisely states, the electrical journals offer a weekly encyclopædia, bringing individuals in touch with the progress, chronicling the advance of the art which enlists the resources of the capitalists in co-operation with the investigations of the electrician in a work whose application extends to the welfare of all.

Sir Henry Mance aptly said, in his Presidential Address to the Institution of Electrical Engineers, and in so saying paid a compliment to the Electrical Press which we highly appreciate, "figures and facts in connection with electric lighting and traction must be so fresh in the memories of those who study the weekly technical journals, that I abstain from intruding them on your notice." We have no jubilee to celebrate at the moment, for the silvern epoch of our existence will not be upon us till near the end of the present year, but we take this occasion to congratulate ourselves, and at the same time congratulate our readers and friends on the ever widening and improving prospects of the electrical industry.

THE "RAPID CABLE."

The increasing popular interest in scientific research, and its practical application, is well exemplified by a recent report of an interview which a representative of the *Pall Mall Gazette* had with Prof. Silvanus P. Thompson, F.R.S., on the subject of the proposed Pacific cable. The article is entitled "The Pacific Cable made Possible," and refers to a novel method of overcoming the difficulty of *retardation* in a cable, of which the *Pall Mall Gazette* says: "Although an open secret to a few far-sighted people has never been published."

The construction of the "rapid cable" which Prof. Thompson is said to recommend, we give in his own words as reported:—

"My cable has two separate conductors, each perfectly insulated and inclosed within the same armour. At intervals of every 100 or 150 miles I introduce stretches of cable with three separate conductors, the third being a wire of high resistance acting simply as a leak. One end of it is connected to the positive conductor, the other to the negative. In this way the static charge on the positive conductor simply neutralises that on the negative, and by introducing a sufficient number of such leaks the retardation can be entirely got rid of." This principle is very similar to that explained in a patent, No. 22,304, taken out by Prof. Silvanus Thompson in 1891. That specification says:—

"The simplest case consists of the use of a number of compensators arranged in parallel across the two conductors of a cable. These compensators consist of a wire of high resistance coiled round a core of well laminated iron joining the two conductors. The coil is covered with insulated material, and its choking or its self-inducing action, if it consist of a sufficient number of turns of the fine wire coiled near together, will cause sufficient resistance to prevent all but an insignificant quantity of the working charge to short-circuit. In electric cables the induction coils must be further arranged so as not to form unwieldy enlargements of the cable, and are preferably long and narrow, and with the axes parallel with that of the cable. The specification contains 14 illustrations, showing various arrangements of choking coils, or of mutual induction, or of transformer coils connected in series or in parallel with two or more conductors in a cable. In all cases it is necessary that the compensators must be distributed through the length of the cable, so as locally to counteract the effect of the static inductive capacity of the cable, which is itself distributed over the whole length of the cable; and that the completeness of the counter action will depend upon the compensators being sufficiently numerous, thus locally to destroy the ill effects of static induction."

It appears, then, that the above methods patented in 1891, are to be superseded by the new arrangement communicated by Prof. Thompson to the representative of the *Pall Mall Gazette*.

That the speed of signalling would be greatly increased by means of so simple an expedient is, as the learned Professor remarks, "*obvious;*" but whether "an Atlantic cable with three stretches, such as I have described, would transmit signals four or five times as quickly as the best single core yet laid, while with five it would transmit seven or eight times as quickly," remains to be proved. What the "high resistances acting simply as a leak," in the case of an Atlantic cable, should be, we are not informed; but it is clear that if very high, the retardation of signals due to static charge will be far from inconsiderable, while the conductor resistance will be double that of a single core.

Moreover, the more effectual the leaks for facilitating discharge, the higher must be the E.M.F. of the signalling battery to make up for loss, and the more likely, therefore, to develop a weak point near to the ends where the majority of faults occur.

As to the difficulties of repairing such a cable, we are informed that "experienced cable manufacturers admit that the change would be perfectly simple, and that it would not even involve any new difficulty as regards even the finding or repairing of faults."

With regard to *repairs*, the difficulties will depend on what the so-called "*stretches* of cable with three separate conductors" may mean. If several miles in length, and the repair entails cutting into one of these *stretches*, the whole stretch will probably have to be recovered in order that the new cable spliced in may give approximately the same *leak* resistance as the cable requires at this point.

It may easily be imagined that considerations of weather, depth, bottom and mechanical condition of the cable might make this necessity (which does not apply to a uniformly constructed cable) inconvenient, and a considerable addition to the cost of repair.

Although for mechanical reasons, interchanging the ends of the two conductors would be of no consequence, some additional trouble would be given to the electrician in tracing ends when splicing up, if he wishes to secure a correct record of the capacity and the electrical values at 75° F. of the C R and D R of the two conductors for future localisation tests.

The consideration of localisation tests, from the "experienced cable manufacturer's" point of view, one can easily understand would be of trifling moment; but to the electrician it would certainly be otherwise. The localisation of a difficult fault, or worse still, *two* unsteady faults, is not undertaken with a light heart, even in the case of an ordinary cable, as it requires considerable patience and resource, so that we can cordially sympathise with the electrician of the future who is called upon to determine the position of a fault in such a complex system.

Under these circumstances, we would seriously counsel the electrician, in the words of Sir Henry Mance in his Presidential Address at the Institution of Electrical Engineers, to

"keep his head cool," though we cannot add his advice "use few formulæ."

The position of an electrician on board a repairing steamer with the engineer-in-charge impatient for results, would be pitiable in the extreme.

Take the case of one or two of the leak resistances between the testing station and a variable "*earth*" fault. We do not say the localisation of such a fault under these conditions would be *hopeless*, but many an expert electrician might reasonably so regard it.

Again: Supposing the conductor only has parted and remains well insulated within the gutta covering, a *capacity* test is impracticable, since the whole capacity of the cable is always in circuit through the *leaks*. Or again: Suppose one side of a fault is sealed and the other end exposed to the water, neither a *capacity* nor a C R test would give any reliable results when *leak* resistances connect the two conductors.

Prof. Thompson is reported further to say in connection with the contemplated Pacific cable:—

"The obstacle to a Pacific cable all along has been the 3,600 miles stretch from the Sandwich Islands northwards. Even if a very heavy copper conductor were used, experience shows that 12 words a minute is the utmost one could hope for from a single wire."

Whatever the real "obstacle" previously existing may have been, the Conference lately sitting in London has—so the Press tells us—just reported favourably on the scheme. Moreover, as a matter of fact, the cable distance from the Sandwich Islands *northwards* is only 2,279 knots, which, allowing for slack, would be approximately 2,510 knots. How many words per minute will be possible through the length Prof. Thompson mentions depends, of course, on the core used; and as to such an indefinite statement about the speed, we can only say that we shall be better able to judge what speed may be counted on when we know what is the weight of the "very heavy" conductor he refers to, and also the weight of the dielectric.

We have reason to know that calculated speeds differ very widely according to the data used as a basis of calculation; and as the cost of the "rapid cable" is said to be "less than double the cost of an ordinary single cable," this considerable difference would be available for increasing the size of the core.

"The maximum speed on an Atlantic cable is (according to our informant) somewhere about 32 words a minute. In early days it used to be 8 or 10." According to our knowledge, the usual working speed for the lighter core Atlantic cables is about 25 words per minute; while for the heavier core recently laid, nearly 50 words per minute have been found practicable. The employment, moreover, of an automatic curb transmitter with an adjustable curb is said to have increased the speed of working some of the Eastern Telegraph Company's cables at least 30 or 35 per cent. As for the statement, "that the speed in early days used to be 8 or 10 words," this would only show how improved apparatus has increased the speed, which is a consideration applicable to any kind of cable.

With regard to the syphon recorder and curb sender being "the chief agents of improving the speed," the increase in speed derivable from this particular curb sender has not been so marked as to commend it for general use; and the mirror speaking instrument, which has been in use from the time of the first Atlantic cable, is at the present time as sensitive as any syphon recorder yet invented; although the latter has largely superseded the mirror, owing to the fact that a record of messages is secured.

Nor can we accept the lax statement that "the more perfect the insulation, the greater is this capacity and retardation." As a matter of fact, the reverse is the case.

That the speed may be increased by inserting a *leak* between the conductor and "earth," or by a small fault in the insulating covering to facilitate the discharge of the cable between signals, is well known; and, from subsequent remarks, is evidently the point which the Professor wished his interviewer to understand; but, as stated, it is incorrect.

In making these comments on our esteemed contemporary's article, we must not be supposed for a moment to wish to minimise the advantage which Prof. Thompson claims for his "rapid cable," our object being, in view of the extreme importance of the subject, to place the comparison clearly before our readers as far as our present imperfect information as to his system permits.

Kosmos?

THE Kosmo system of concentric wiring is a new attempt to apply concentric cables, having the outer conductor insulated, to interior wiring. The objections that have been urged against an insulated outer system of concentric conductors are, greater cost than wood casing and the great difficulty of effecting satisfactory mechanical connections with switches, fuses, and fittings. So great has this difficulty always been that no one has yet succeeded in overcoming it, and, like the Kosmo system, the practice has been to make connections by two wires as in the double-wire system. In the Kosmo system it is claimed as an advantage that the outer conductor is twice the area of the inner; this, however, should be looked upon as an unnecessary expense, seeing that protection is given by an outer insulation and lead. The fact is, in small concentric cables, the outer conductor, when only of the same size as the inner, will not surround the inner insulation with any practical degree of thickness, hence the necessity of increasing the metal. Fixing a conductor to the wall with saddles, as suggested in the Kosmo system, is an unsightly arrangement having resemblance to an elongated centipede. The wood casing and picture rail method is preferable. The advantages of a concentric system of interior wiring almost entirely vanish when it is attempted to work it out with the outer insulated, and in the system under review there is no new feature which compensates for the advantages of the earthed concentric system. On the whole, we look upon it as a little unfortunate that an additional system, possessing no special advantage, should be launched to add to the confusion of systems that already exist.

Electrolytic Silver Peroxide.—In the *Zeitschrift für Anorganische Chemie*, O. Sulc describes an investigation on the deposit which is formed during the electrolysis of silver nitrate between platinum electrodes. He employed a platinum dish as the cathode, the anode being a comb-shaped piece of platinum foil rolled up. The electrolysis was conducted upon a 15 per cent. solution of silver nitrate, the density of current at the cathode being 0·0033 amperes per centimetre. He allowed the electrolysis to go on for about three hours, then removed the free nitric acid which had formed, and continued the electrolysis. The product formed as a deposit was found on analysing it to have the composition represented by the formula $Ag_7 NO_{11}$.

THE INSTITUTION PRESIDENTIAL ADDRESS.

Sir Henry Mance, the new President of the Institution of the Electrical Engineers, in his inaugural Address to the members on the 14th, struck an almost forgotten note in the gamut of applied electrical science.

Like a breath from the ocean, stirring the wires of an Eolian harp, it revived breezy recollections in the memories of the older members, and must have opened up new visions of other spheres of activity to the view of the younger scions of the craft.

We, of course, allude to that section of the President's Address devoted to submarine telegraphy, a subject which has for many years past fallen into semi-obscurity amongst the discussions of the Society for lack of some doughty knight to champion its right to command the attention of members belonging to this, the oldest institution representing electrical engineering.

It can hardly be said that this is anybody's fault in particular, for the rapid development of electric lighting, telephone construction, and other kindred work during the past decade has monopolised the time of the house to the exclusion of cable work, in which it was thought there could be nothing novel.

Sir Henry forbore to inflict his hearers with statistics in connection with electric lighting and traction, which was doubtless a relief to many present. Upon these topics but little was said by the President, and that was principally to the point of predicting a future for traction by means of storage batteries. In casting off from the pier head (metaphorically speaking) of land work, the new President carried his hearers back with him to the year 1812, the earliest record, he said, of a subaqueous line. From this starting point an easy and agreeable journey over a wide range of subjects was accomplished, reviewing the first efforts to effect telegraphic intercourse across the Channel in the early fifties; the subsequent work carried out during the 16 years following, in extending the means of communication in various parts of the world; the failures resulting from the adoption of unsuitable types of deep sea cable, and the consequent loss of nearly half of the 20,000 miles of cable laid during that period.

In touching thus lightly upon the earlier failures in cable laying, the President was wise. Valuable experience has been gained, and successful work has resulted since those early days. In the too brief account of the expedition to the Persian Gulf, we learn that Sir Henry himself dates his first experience with submarine telegraphy from that occasion.

A little more enlargement upon the re-introduction of sun signalling after such a lapse of time as 2,000 years and more would have been interesting, particularly as Sir Henry Mance figured so prominently in it himself, but for this reason, perhaps, the President was reticent upon this point. It is a singular fact, and one which shows the proverbial slowness of home government departments, that the heliograph was first adopted in a foreign army.

The comprehensive figures furnished of the number of cables existing, and their aggregate length, gives food for reflection. Why, with nearly enough cable already submerged to encircle the globe seven times, have we not completed Puck's girdle round the earth? Why, with four-fifths of the circumference of this planet endowed with those pulsating nerves that transmit the ideas and the wants of mankind between the nations of the world, have we not put in the missing link, and formed a continuous circuit? The answer must surely be "vested interests," that evil talisman that retards progress by the sophism of "let well alone;" everybody is served, therefore everybody is content. But this condition of things cannot now continue to be a reproach to the leading nation in maritime affairs, and colonisation, for we are assured of being well within measurable distance of the accomplishment of this important piece of work.

The President sounded a note of alarm when he said that England can no longer boast of a monopoly in this business. The development of French submarine telegraph enterprise is certainly a costly luxury to the French taxpayer, and when he gets to know that cables can be made and laid successfully at about one-third less by English firms, we doubt which will influence him most, his patriotism or his pocket. As for the Government cable works at La Seyne, that establishment may be looked upon principally as a model factory and training school. At St. Tropez, about 600 knots of cable was made in 1892, and was laid between Marseilles and Bizerta, La Goulette, and Tunis in 1893, from an English cable steamer, with English officers and crew. The works at Calais are probably the larger, and have turned out most work, but taking them all, with the Italian works at Spezzia thrown in, we shall attach no more importance to the fear of our monopoly in cable manufacture passing very quickly from us, than Sir Henry Mance does to the much talked of telegraphic isolation of England, which is feared immediately we are involved in warfare with any great European power.

In his remarks upon the subject of ocean depths, the President, when he comes to shallow water, does not tell us what are the depths he has in mind where the bottom is subject to current tides and waves, and where, owing to this action, it is frequently irregular. We know of places where current action extends to a thousand fathoms, and sweeps the ocean floor clean of all deposit. Also at depths approaching this, where the clay is so hard that grapnel prongs are straightened, and where within a few miles a cable has been found to be chafed through on the bottom, evidently by the action of currents and transmitted wave force.

Many, indeed, are the dangers to which these comparatively slender threads are exposed after being deposited quietly upon their oozy bed at the bottom of the sea. The forces of Nature are there silently and invisibly active, and conjecture only can suggest which of the many causes enumerated by Sir Henry are responsible for the interruptions that occur. Submarine landslips, and outlets of subterranean streams, in some instances occurring far out at sea away from a coast, being to all appearances the most common.

Still more curious faults have occurred than the one referred to by the President, and without the explanation of a slope on the bottom to account for them, the same conditions of the cable have been present, the sheathing wires being straightened out upon one part, and twisted up on the other, and the whole cable curled up into figures of 8 upon a practically level bottom in shallow water, the only feasible way of accounting for this extraordinary plight being the action of currents and movement of shifting mud banks, which probably pinned the cable down in one place, while the movement of the tide rolled the cable over and over, taking the turn out or in, in the same manner as a sailor will roll yarn to lay up into spun yarn.

The application of a preservative tape and compound to each of the sheathing wires of deep sea cables is a most valuable improvement in their construction, giving all the advantages that the President set forth—and more.

The wires of grapnel and buoy ropes should certainly be treated in this manner, for the action of sea water in tropical climates especially is most destructive to steel wire and iron chains.

The notes given by the President upon the amount of spare cable necessary for maintenance of lines of cable are open to criticism. We may take it that Sir Henry means, by comparatively shallow water, the depths generally obtaining over the system of the Persian Gulf lines, which is on an average about 45 fathoms.

The figures quoted in the table would, we think, hardly apply to shallow water cables in other parts of the world. Take the North Sea, or the Irish or British Channels, and the shallow depths around the coast of the Gulf of Mexico for examples.

In the case of cables laid in depths of from 300 to 500 fathoms, which must also be considered shallow water comparatively, during the first 12 years no expenditure of cable has been required, but after that, between the 12th and 13th years, as much as 11½ per cent.

In bestowing well deserved praise upon our countrymen telegraphists, who work long submarine cables, for their expert reading of the instruments in modern use, Sir Henry performed a graceful act which will afford great satisfaction to a large body of clever and intelligent men, serving, as they do, the best interests of civilisation. His advice, also, to telegraph administrations to encourage their servants at foreign stations to render themselves proficient, and acquire

a knowledge of testing, is sound. In this, however, as in other spheres of life, the desire to improve is generally found to succeed when the individual takes the initiative.

The President's advice to young beginners will no doubt prove valuable to many. The electrician, like the navigator, should use simple formulæ with few figures when on board ship, for rapid action is of paramount importance, especially in stormy latitudes, when delays are dangerous. At the same time, as Sir Henry remarks, it is well to keep the head cool, and, we would add, not to take more concern in the safety of the cable hanging over the bow than the cable engineer, who is not only responsible for its safety in that state, but also for the speedy restoration of traffic over the cable, which may mean thousands to the telegraph company whose income has been suddenly cut off.

The fact, as pointed out by the President in the opening part of his remarks, that this year may fairly be considered the jubilee of international telegraphy, coupled with the fact that it is the completion of the 60th year of Her Majesty's reign, so prolific as it has been in the development of science, art and industries of all kinds, renders this session singularly auspicious, the Institution entering, as it does, into its 26th year of existence. It is a good augury for the telegraph engineer, and circumstances appear to favour the consummation of his great desire to establish a girdle round the earth.

The committee that has been holding conference at the Colonial Office at intervals since last June, completed its labours early this month, recommending the speedy carrying out of the trans-Pacific cable from Vancouver to Australia. With the seal of Imperial approval it may well be regarded as the first step towards providing an all through British system, which shall be as assured from interruption in hazardous times as it is possible to hope for. The President's observations upon the difficulties of cutting cables in deep water are weighty, and should serve to dispel the popular illusion that work of destruction could be carried out by 20-knot cruisers in something like the twinkling of an eye. On the other hand, cable cutting in very shallow water near to the coast can be easily done by any small steamer with a purchase gear that will raise an anchor, and not only be cut, but lengths be removed, which would tax the resources of a repairing steamer to replace. Men-of-war are not ubiquitous. Like the gentleman in blue of civil life, when watched off his beat, then marauders can have a high old time.

Telegraph engineers do not concern themselves with politics where work is concerned, yet they should remember that a well known and distinguished Canadian engineer, Sir Sandford Fleming, has supported the project of the Pacific cables against much opposition, and has, during the sittings of the conference, given the benefit of his advice as an expert to the Canadian delegates. In fact, the Dominion, although not deriving so much benefit from the scheme as the mother country and the Australian Colonies would, has throughout fully appreciated the immense strategic importances of these cables to the Empire at large, and Mr. Laurier, the present Premier, together with Sir Richard Cartwright, the new Canadian Minister of Trade and Commerce, with their colleagues, are of one mind in their intention to co-operate in all that may be required to make the lines of communication a success.

(*To be concluded.*)

THE NORTHERN SOCIETY OF ELECTRICAL ENGINEERS.

The subject of the presidential address delivered before this Society by Mr. C. M. Dorman, on January 11th, was "Radiation." This term was somewhat too wide for the subject matter of the address, which would evidently have been more accurately entitled, "Vibration;" for strange to say, there was no allusion in it to the Röntgen rays, which in these latter days appear to be looked upon as radiation *par excellence*, since by these rays alone do we obtain "radiographs." But perhaps Mr. Dorman's title was purposely chosen as a silent rebuke to this recent solecism in our scientific terminology.

Mr. Dorman evidently set himself the somewhat ambitious task of explaining to his audience, in popular language, the electro-magnetic theory of light; and we are bound to admit he has succeeded remarkably well. How many, with insufficient mathematical equipment, have burned the midnight oil trying in vain to extract the kernel of Maxwell's theory from its shell of double and triple integrals, spherical harmonics *et hoc genus omne?* We recommend such unfortunate students to read Mr. Dorman's address.

Mr. Dorman commences by illustrating, by hypothetical monocords, the formula for the velocity of waves through elastic bodies—the well known, Velocity $= \sqrt{\frac{\text{Elasticity}}{\text{Density}}}$. To those who wish to obtain a rigid proof of this formula by elementary mathematics, we would recommend that given by Prof. Tait in an article on wave motion in the *Encyclopædia Britannica*. It is an intellectual acquisition worth possessing. Building on this foundation stone, Mr. Dorman shows, in language which may be understood of the people, how that grandest superstructure of nineteenth century science—the electro-magnetic theory of light—has been erected.

It is the inherent defect of all popular expositions of abstruse subjects that they must be somewhat long winded. We do not say that Mr. Dorman has used a single unnecessary word to make the subject clear to the audience he was addressing, but the elaborate illustration of the properties of waves must appear to be somewhat too much cry for little wool, except to those unacquainted with the elements of the subject. When he proceeds, however, to apply the laws of wave motion to the electro-magnetic field his exposition is decidedly interesting, and will be so, we think, even to those who have already mastered the subject by more abstruse mathematical methods. By showing the analogy between specific inductive capacity and elasticity, and between magnetic permeability and density, he deduces the equation for the velocity of an electro-magnetic wave in the ether. This, as we now know, is equal to the velocity of light. Maxwell's hypothesis of the identity of light waves and electro-magnetic waves has been amply confirmed by experiment, and from this vigorous germ has sprung, perhaps, half the remarkable scientific discoveries of the end of this century.

Presidential addresses of the type of the professorial lecture to a society of professional electricians are somewhat of a new departure, but the subject in this case was one which is of the greatest interest from the theoretical point of view, and which is by no means generally understood. Presidential addresses of the statistical type are getting played out; as Sir Henry Mance remarked in his address to the electrical engineers, the electrician can become sufficiently acquainted with the statistics of the progress of his profession by reading the technical journals. The dissemination of the latest scientific news is now so much improved, that there is little left, even for an expert, to tell an audience of scientific or technical men. What might be called the original research presidential address, of which Prof. Crookes's address to the electrical engineers was so brilliant an example, is somewhat rare; since new discoveries cannot usually be put in sufficiently popular form. By all means, therefore, let us occasionally hear from the presidential chair the language of popular science, whereof Mr. Dorman has proved himself so capable an exponent.

AN EXTRAORDINARY LIST OF TENDERS.

The tenders that have been sent in for the lighting of the New Infirmary Buildings at the Portsea Island Union Workhouse exhibit such extraordinary differences, that we feel justified in drawing attention to them. The list of tenders, with the one accepted, is as follows :—

	£	s.	d.
Messrs. Mallett & Co.	621	0	0
„ T. S. Anderson	530	0	0
„ H. J. Joel & Co.	514	0	0
„ Smeeton & Page	453	7	6
„ Wenham & Waters	402	10	0
„ Walker & Co.	397	0	0
„ Pearson & Co.	389	14	6
Mr. S. Grossmith	389	0	0
Messrs. Williams & Sons	367	0	0
Mr. J. R. Penning	359	12	0
Messrs. Forbes & Co....	319	11	0
„ New & Mayne (accepted)	248	0	0

It is obvious at the first glance that either some firms are anxious to make large profits, or that others have tendered without an adequate knowledge of the work to be done. As a matter of interest we have gone through the specification, and we find that the gas piping, &c., is included in the electrical contract, and comprises some 300 yards of 1-inch, and 300 yards of 1½-inch iron piping placed *in* floors. There is then the wiring for 220 lights, 130 of which are to be run in insulated piping along and *inside* fireproof walls and floor. 198 switches are to be provided, and 12 standards at 15s. each; there are main switches, double-pole fuses, and seven distribution boards. Several special fittings at £2 and £2 10s. are asked for, and such luxuries as painting the casing with four coats of paint are required.

With the assistance of a well-known firm of electrical contractors we have, from a careful study of the specification, arrived at the following prime cost figures of lighting the Portsea Workhouse:—

	£
Gas fittings and labour	83
Wiring and labour on 220 lights	165
Fittings, switches, fuses, roses 8s....	88
Allowances as per specification	17
Main switches and distributing boards	24
Special fittings	13
Contingencies	10
Lamps	14
	£414

Yet the tender accepted amounts to no more than £248. It is very clear that our methods of calculating the cost of electrical wiring and fittings are hopelessly wrong-headed, or that serious errors have been made by some of the tenderers.

It is to be at any rate sincerely hoped that this is not an example of cutting prices. We have over and over again pointed out the folly and futility of such courses and reckless competition is all the more to be deplored at a time when business in general is in a prosperous condition.

MOTOR CARS.

January 22nd is a red-letter day in the journalism of engineering. It marks the commencement of our venerable contemporary, the *Engineer's début* as a comic paper. This *début* is started off by a letter from "An Outsider" on the motor car show at the Imperial Institute. True the writer apologises for his acidity; but he claims, with a fair approximation to truth, that he has distributed his acid evenly, which is all very well, but there is so much of it. He has one little allusion to what he terms the milk cart method of mounting, borrowed from the early matutinal exhibition throughout the suburbs of a man or boy (in multiple arc) running after his cart, which the intelligent animal has already proceeded to move on to the next customer. Only, says "Outsider," with the motor bicycle the man is also *the* beast. He carefully uses not the "indefinite" article, which would have been perhaps too definitive to please the man. This allusion to milk and to humanity is the only strain of the milk of human kindness in "Outsider's" letter. It really is very funny, and for those in whose nostrils the motor car stinks, and we fear many of them do so, both actually and metaphorically, this letter will be delicious reading. We attended the Imperial Institute ourselves, and saw what we could of running motors, and a good deal of motors at rest, and we were ourselves struck with the resemblance of motors to British workmen, for both seemed to be named on the *lucus a non lucendo* principle. We were at Hurlingham, too, and drove in fine style round the grounds there on the Delahaye car, which struck us as deserving a little better praise than "Outsider's" acid drops. At the Imperial Institute we saw the expert of another motor car company riding round the course in friendly converse with one of the directors of the Great Northern Railway. As they vibrated round the track with teeth mechanically chattering, the expert seemed to be comparing his pet car with the Daimler car, not to the advantage of this latter, while the G.N. director, with stern visage and knitted brow, evidently had his mental eye fixed on one of Stirling's magnificent 8-footers, and could see it crashing along over the fens and dykes of marshland; for when he had alighted, he shook his head and walked sadly away. Very funny is "Outsider's" allusion to Mr. Bersey's car, which started on November 14th for Brighton, and having crossed Westminster Bridge, steered for Victoria, and was met the same evening coming down the Station Hill at Brighton. There is a hiatus here, which we infer is left for the reader to fill up for himself. Anyhow, nothing is said as to the distance from Westminster to Brighton further than the allusion to two terminal railway stations.

The Britannia Bath chair is playfully alluded to. Now, we have ridden in this ourselves; to wit, the length of a cellar, on a nice linoleum, somewhere in Tottenham Court Road. We saw the fore-mentioned expert there also. He gazed sadly at the huge excrescence upon the back axle, and seemed to be endeavouring to calculate the performance of a big clock spring, as though he suspected the motive power.

"Outsider" has the unhappy knack of just hitting off the weak points in all the motor car tribe, including the great chieftain of the race itself: to wit, the Juggernaut—we mean the Serpollet car. The motor car has exhibited a singular propensity for breaking down in some little detail having nothing to do with the principle. Then if an axle breaks, it will be the one with the light load, not that carrying the motor; and, of course, an impatient and undiscerning public place it all on the principle. The "shriek" of the starter clutch, the antics of the riders of cycles when these have no clutch, but must be started by running them along, the vibration and general unhappiness, are all touched upon. A belt gear in a carriage is not, perhaps, altogether fitting in idea, but from what we have ourselves observed, we should say there is nothing like leather, for the belt connection with fast and loose pulleys appears to be by far the most successful system of connecting a motor with a driving axle. You start your motor with the carriage under cover, and when the body of the carriage is all ajig, you mount and slowly move the belt lever, and out you drive into the open, the jigging calms down and off you go, and the motor need not stop again, but you may stop the carriage every few yards. Sometimes, if the carburators are not in order, there may be trouble for want of gas or vapour, unless the great Lawson of motoriety be about, and a few great horseless shareholders, for then gas seems plentiful. We must congratulate our contemporary on its new departure. "Outsider" has done much to lighten the heavy columns of the *Engineer*.

FUTURE ELECTRICAL DEVELOPMENT.

Prof. Dolbear, of Boston, has been holding forth to a representative of the *Western Electrician* on the marvellous future in store for electricity in the service of man. Some good shots in this line of prophecy have been made by writers of fiction of the Jules Verne type with a smattering of science, but the more a man knows of the present state of knowledge the more likely he is to err, by going too much into detail. But some of Prof. Dolbear's prophecies, we fear, are not even quite justified in the light of our experience up to date. For instance, he seems to think that vacuum tube and phosphorescent lamps have a great future before them. But Moore's vacuum tube light, and the Ebert, Edison, and Tesla phosphorescent lamps have up to the present proved practical failures. Theoretically they promise great things, but in the course of experiment difficulties have been met with which are fatal to their durability, and appear to be insurmountable. As Professor Dolbear points out, there is much room for improvement in the efficiency of our present system of electrical lighting. "The steam engine," he says, "gives back but 5 per cent. of the energy turned into it, and the incandescent lamp no more than 5 per cent. of what is turned into it, so between the coal and the light there is a great loss of the energy spent to produce it." No doubt future research will reveal some more economical method of producing light than this; but it is as likely as not to be on quite different lines from those now in favour with inventors.

Prof. Dolbear prophesies a great future for telegraphy and signalling by the Hertzian waves; and experiment seems to

point to the probability of this being done within limited distances. But when he prophesies that "the time is close at hand when the steam locomotive will be as much a curiosity as any old fire engine," he assumes the discovery of an electric accumulator, or a means of transmitting electric energy far superior to anything we are at present acquainted with.

Diamonds, sapphires, rubies and emeralds are, according to the vaticinations of Dolbear, to be within the reach of the poorest, when manufactured wholesale in the electric furnace. The recent diamonds produced in this way by Slaby are said to be considerably larger than the minute crystals made by Moissan, but no panic has on that account threatened the diamond market.

The application of electricity to medicine in recent years has made wonderful progress; but we think the results achieved, and promise for the future, are described by Dolbear in somewhat too glowing colours. He says: "Material can be transfused into the body through the skin without rupture; poisonous material can be extracted from the body in a similar way. Anæsthesia can be produced anywhere, so surgical processes can be carried on without pain or loss of consciousness, whether for tooth pulling or for amputation of any sort. Tumours and such abnormal growths have been reduced and destroyed by it. Metallic masses accidentally embedded in the body can be located, and needles extricated without even touching the skin. Electricity is also the bearer of energy, and it may be directed to any organ needing assistance without depending upon such a roundabout way as is always the case when a drug is taken into the stomach to repair, say, the lungs. A knowledge of electricity, and its employment for physiological purposes, will soon be a part of the equipment of every physician in every one of the numerous special departments into which the science is now divided."

But the learned professor goes clean off into Utopia when he tells us that "electricity is an agency by which molecules may be loaded with energy, and the advance in both chemistry and electricity is of such a character as to warrant one in believing that ultimately all the bodily wants may be artificially supplied." The apparent direction of progress at the present time may in a few years be completely changed by some epoch-making discovery. Prophecy, as George Eliot has said, is the most gratuitous form of error.

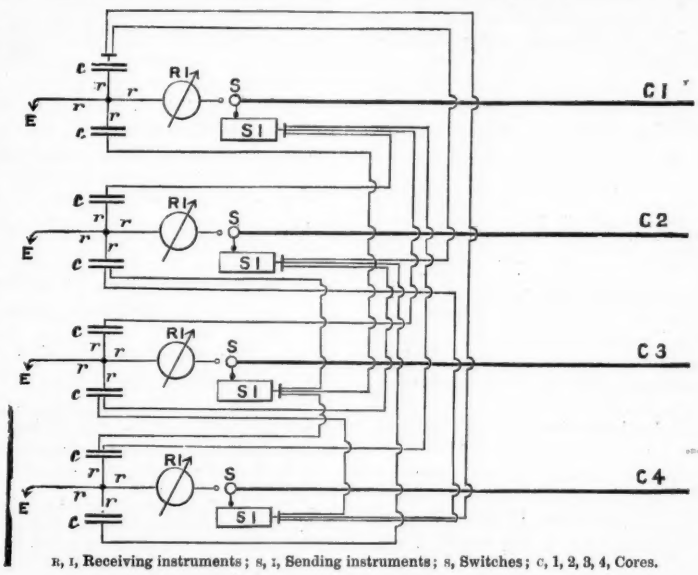
CORRESPONDENCE.

Induction in Multiple Core Cables.

I have read Mr. Preece's letter in your issue of December 11th ult. with much interest. Mr. Preece reminds me of the fact that he developed the whole principle of shielding conductors in multiple core cables from the effects of electrostatic induction, and that he actually used tinfoil for that purpose in the streets of London as early as 1878. On the Continent of Europe Messrs. Felten & Guilleaume were the first to introduce tinfoil covered cores in their aerial telephone cables, which plan was adopted by the Copenhagen Telephone Company in 1883 with much success.

The utilisation of brass tape, or any metallic sheathing, round each core in a *submarine cable*, as a remedy against induction from core to core, marks, however, a distinct progress in submarine telegraphy; in principle it was first proposed by Mr. Gulstad and myself in 1891, independent of what had previously been done either in aerial or subterranean cables; and great credit is, I think, due to the Post Office and those responsible for the construction of the new Bacton-Borkum cable for having given this sheathing, originally meant as a protection against teredoes only, an extended and two-fold application.

It seems, however, from Mr. Preece's paper, read before the British Association, September 23rd, 1896, that there is still some disturbance observable between the cores of this cable, and that the induction would probably disappear entirely if the electro-magnetic effect, which is not screened away by the brass taping, were removed also. What I venture to suggest is, that the remaining inductive effect can be eliminated by *inserting condensers and variable resistances* between the cores in the manner described in the paper previously referred to, viz., "Remarks on Induction in Multiple Core Cables," and published in the ELECTRICAL REVIEW, May 22nd, 1891, p. 644. By this arrangement, which enables momentary currents to be sent through the receiving instruments in a direction opposite to that of the inductive impulses from the cores, thereby balancing the one against the other, all inductive disturbance is neutralised on the Great Northern Telegraph Company's multiple core cables in Chinese and European waters. The system is also used with perfect success on the Norwegian-German cable (Arendal to the island of Sylt), which contains three cores, and is 250 nautical miles long. Not only the electrostatic but also the electro-magnetic effect, which latter, however, is very little felt, can be done away with by this means; it only requires a combination of condensers and adjustable resistances, and on a 4-core cable, like the Bacton-Borkum cable, eight condensers and a corresponding number of resistance coils would be needed.



R, I, Receiving instruments; S, I, Sending instruments; S, Switches; C, 1, 2, 3, 4, Cores.

The diagram shows the connections when four cores have to be screened mutually (*r* represent variable resistances, *c* condensers) and requires no further explanation. The condensers may have a capacity of something like one microfarad each, and adjustment of the resistance coils, &c., can easily be effected.

P. Chr. Dresing.

Copenhagen, *January 23rd*, 1897.

Speed Regulation of Direct Current Motors.

The article on the "Speed Regulation of Direct Current Motors" in the ELECTRICAL REVIEW of January 8th, has been productive of good results. Thanks to Mr. Atkinson, we learn that the method of "E.M.F. control" has been proved to be successful in practice, and that in his opinion the method of control is perfect.

I am not quite sure that Mr. J. R. Dixon fully appreciates the point of the method.

What is to be more especially noted is, that the "E.M.F. control" *automatically keeps the speed practically constant* under a load varying to any extent whatever, whereas, constant speed can only be obtained with "ohmic control" *by*

turning the handle of a regulating switch. The use of the regulating coils in the "E.M.F. control" is solely to adjust the speed to the required value. When once adjusted, the speed will remain practically constant, no matter how the load may vary.

Mr. J. R. Dixon's suggestion as to the capability of working from a supply company's mains seems to me simply the conversion of the machine into an ordinary shunt motor.

The Writer of the Article.

Mechanical Theory of Electricity and Chemical Action.

If you will kindly permit me I should like to offer a few more detailed criticisms of Mr. Whitwell's theory.

In the first place, I think there can be no doubt that we must abandon the hypothesis of variable ether density. Well may Mr. Whitwell complain (p. 63) of the difficulty of determining the direction of the change of density round a long straight wire! It is precisely the difficulty that I pointed out in the case of the ring. The equipotential surfaces are radial planes, the lines of force are circular, and as we proceed along a line of force the field is of uniform strength. In such cases the hypothesis of increasing ether density breaks down hopelessly.

Mr. Whitwell shows in his letter that he partly appreciates the force of this objection, but he tells us in explanation that the lines of force are not circular but *radial*. To think that we have been designing ring transformers all this time without finding out a simple fact like that! But what becomes of these radial lines of force? Do they stick out from the coil "like quills upon the fretful porcupine?" Statements such as these prepare us for such minor shocks as the apparent reversion to a corpuscular theory of light on p. 98.

Again, if we refer to fig. 5, we have an excellent picture of what Hertzian radiation means on this hypothesis. Discharge a Leyden jar round the solenoid and what do we get? A series of *ether sound waves* propagated axially. Such waves would be *incapable of polarisation*. Thus at every point does this theory come into conflict with fact.

Abandoning now this untenable hypothesis, and assuming for a moment that in some unexplained way these molecular rotations are set up, let us consider what is left. We still have the very significant equations on p. 36, which I will write as follows:—

$$\mathrm{M}\,\omega\,\frac{d\,\omega}{dt}\,dt + \tfrac{1}{2}\,\frac{m^1}{n}\,\mathrm{M}\,\omega^2\,dt + \mathrm{N}\,\frac{\omega}{k}\,dt\int\omega\,dt = \mathrm{N}^1\,p\,r\,\omega\,dt \quad (1)$$

$$\mathrm{L}\,\mathrm{C}\,\frac{d\,\mathrm{C}}{dt}\,dt + \mathrm{R}\,\mathrm{C}^2\,dt + \frac{\mathrm{C}\,dt\int\mathrm{C}\,dt}{\mathrm{K}} = \mathrm{C}\,\mathrm{E}\,dt \quad (2)$$

(I would here point out that if Mr. Whitwell had written displacement as k times force instead of the converse equation (1) would have assumed the above form, and he would not have been led into making the curious statement (p. 36), that "the capacity of an electric circuit is inversely as the specific inductive capacity of the medium.")

At first sight is seems as if some real physical meaning must lie behind these equations, as if current must mean molecular angular velocity. Let us analyse them. We have three terms—the magnetic, the dissipative, and the electrostatic energy terms. As regards the first, the similarity in form between the expressions $\frac{1}{2}\,\mathrm{L}\,\mathrm{C}^2$ and $\frac{1}{2}\,\mathrm{M}\,v^2$ or $\frac{1}{2}\,\mathrm{I}\,\omega^2$ is familiar. The third term in each case is of the form that occurs in *all* cases in which displacement is proportional to force producing it, whether in an electric condenser, or in a twisted shaft, or in any other such case. In the second term an apparent similarity is produced by assuming that the percentage loss of energy of rotation in a collision is independent of the angular velocity, in other words that n is *not a function of* ω. We have no evidence of this, and it seems highly improbable. One would rather expect to find the percentage loss of moment of momentum constant. If n *is* a function of ω, the analogy breaks down, for R is not a function of C.

Again, if these equations mean anything, how is it that M—a quantity that must be taken to represent self-induction and to be increased by placing a piece of iron in the field—occurs as a factor in the expression which represents resistance? We shall not find the *resistance* changed by the approach of our piece of iron. I think we can only conclude that the apparent similarity of these equations is not significant of any physical relation between the quantities.

In conclusion, I think that if Mr. Whitwell had satisfied himself with such a simple mechanical analogy as that of a shaft bearing radial air vanes and set rotating by applying a turning moment at one end, he would have thrown no more and no less light on the actual condition of things existing in a wire conveying a current than is shown in his paper. The energy of rotation, $\frac{1}{2}\,\mathrm{I}\,\omega^2$, corresponds to the $\frac{1}{2}\,\mathrm{L}\,\mathrm{C}^2$ term, the heat produced is $\mathrm{R}\,\omega^2$, where R is some constant, and the expression for the energy stored in the shaft in virtue of the torsional strain takes necessarily the form of the third term above. But this is a mechanical *analogy*, not a *theory*, and I am afraid that Mr. Whitwell's complicated system, which bristles with difficulties, cannot be considered as anything more.

H. C. Haycraft.

January 22nd, 1897.

Generous!

In the ELECTRICAL REVIEW of the 8th inst. appeared the following advertisement:—

A steady dynamo-tender may secure a permanent position in charge of a small electric light plant in an educational institution. Address, with references as to ability, "College," E.R., &c.

I wrote applying for the place and received in answer the enclosed:—

Re advertisement "College" c/o ELECTRICAL REVIEW.

Agricultural and Horticultural College,
Holmes Chapel, Cheshire.

Duties.

1. To take complete charge of an oil engine, keeping it clean and in repair.
2. To look after the electrical plant, keeping it in thorough working order, and the house well lighted. The plant consists of 2 motors and pumps, accumulators, 53 cells, 120 lamps 16 C.P. and dynamo.
3. To keep the cisterns in house and yard supplied with water and to look after water pipes.
4. To keep the heating apparatus going when required.
5. To keep the lavatories in house and yard flushed and clean.
6. To keep the sewage tanks clean, the pipes flushed and the precipitate box filled with Ferric Alumina.
7. To make himself generally useful.

Wages, 25s. per week. No allowances.

If you wish to apply for this post, reply before Wednesday, January 20th.

To which I replied as follows:—

January 19th, 1897.

Gentlemen,—In reply to your statement of duties, &c., I should be prepared to undertake all you specify and in addition, to make all the beds at the college, clean all the boots, dust the rooms, fetch water and coals, curl all the housemaids fringes, attend to all the horses and vehicles attached to the establishment, and fill up my time with ploughing and gardening, as from your statement the electrical plant evidently requires no time devoted to it at all, nor presumably any kind of electrical status or skill in the fortunate candidate you select.

I am, gentlemen, &c.

You will notice that the envelope of the communication I received bears the official title of "Cheshire County Council."

I think their statement of duties and my reply will speak for themselves and will only add that I think it scandalous that the C.C.C. should, as a public body, have inserted in your paper an advertisement so utterly misleading, and thereby put scores besides myself to the trouble of writing applications and copying references. What they require is evidently a man who will combine the skill and experience of an electrical engineer with entire willingness to perform the duties of "Boots" at a country hotel, for a "Boots" at any big town would certainly buck at some of the duties the C.C.C's. electrician is required to perform, for the munificent salary of "25s. a week and no allowances."

If all the C.C.C's. public work is conducted in the same spirit, then the sooner the Cheshire electors bundle out all the existing members of the C.C.C. and elect others, the better for Cheshire. Trusting you can find space for this letter.

E. P. C. C.

Block Signalling.

Re-perusal of your second article, under this heading, makes me feel that it demands some further reply on my part, as one much interested in the subject.

If I now understand your views, they are:—1. There must not be two parallel systems of signalling to the driver in use together. 2. No system of working a signal on the engine can be reliable. 3. Fog-signalling apparatus must be put into and out of gear by the signalman.

As regards parallel signals, I am entirely in accord with you, notwithstanding that, under present arrangements, every morning and evening semaphores and coloured lights are together visible; but this is no argument against superseding roadside signals by signals on the engine. As to reliability, I am convinced that my apparatus can be made more reliable than any system of roadside signalling, which, in the nature of things, depends upon the unfailing vigilance of one man, and his success in always identifying his own signal, the fireman's duties often precluding him from looking after signals. From the point of view of safety, the danger signal is, of course, the important one, and in my system the receipt of this depends primarily on the maintenance of the field from fixed permanent magnets, the strength of which is absolutely maintained by the interspaced electro-magnets used for giving line-clear signals, or even by special coils surrounding the permanent magnets and in series with the electro-magnets. Surely a field so maintained may be treated as absolutely certain. This field may, without undue complication be made to act with a large margin of power on four contact-making needles in the one armature (though I consider that two are quite enough), and each of the needles suffices for giving the signal. Now consider what this means: Suppose each needle failed once in a thousand times, the chances against the two needles failing together would be a million to one. With four needles the figures are 1,000,000,000,000 to 1. But this is not all; there will be at least two groups of home magnets, with the same odds against failure at each group, so that the figures become too large to write. They would have to be again largely increased in respect to total failure of both home and distant armatures.

As each needle has its own fault indicator, however, it is hard to see why a failure should occur anything like so often as once in a thousand times, as after the first failure it would be looked to. The apparatus at Dinting must have worked quite 1,000 times without a single failure being noted. How often does failure of contact occur in a telegraph polarised relay with one needle? The battery on the engine may be in two parallels, either one of which can carry on the work in the very unlikely event of a sudden failure in the other; an indicator showing what has occurred. Gradual exhaustion of the battery will always be noticed in time (independently of periodical inspection), owing to the ringing of the bell becoming feeble. Connecting wires can of course be duplicated to any extent.

On the question of who is to control the use of fog-signalling apparatus, I must say that it seems to me that the engine driver is the man who can best tell whether he is able to see the roadside signals, and on my system he can switch in his battery and take danger signals (the important ones), even if the signalman has neglected to switch in *his* battery.

W. S. Boult.

Chelsea, *January 25th*, 1897.

[With the publication of Mr. Boult's further letter, which we have pleasure in inserting, we think this matter should end. In discussing the subject we endeavoured to deal with it on principle, and in relation to that special class of signalling to which it applies. We do limit our views to these hard and fast lines laid down by Mr. Boult. We have expressed the view that railway authorities would not encourage two concurrent systems of signals, leaving the driver to make his selection of that by which he would be guided. We have not said that "no system of working a signal on the engine can be reliable," but we have pointed out that in our opinion the locomotive is not a desirable place for electrical apparatus, and we are still of that opinion. If Mr. Boult is able to overcome the rough treatment which such a location would, in our view, subject it to, we shall be very glad to hear of his success. We are also of opinion that should any subsidiary form of signal be adopted, it should be called into operation at the instance of the man who is responsible for the signalling of the trains. With these comments we close the subject.—EDS. ELEC. REV.]

Electric Supply Company's Wiring Regulations.

In reply to Mr. Percy Still's letter in your last issue, it is evident from the fact that other supply companies have no such rule against consumers' main fuses, and from Messrs. Handcock & Dykes's letter, that I am not alone in my contention that such fuses are useful; and, in fact, except Mr. Still's own opinion, no fresh evidence has been adduced against their use.

The reason why I always have specified for these fuses is that mentioned by Messrs. Handcock & Dykes; but my main point is that for a supply company to decline to connect a house in which they are put in, is exceeding fair and reasonable rules, and is, in fact, *ultra vires*.

It is news to me—and, possibly, to other engineers, that the primary reason for the Supply Company's fuses is to preserve the meter. I had always understood that they were, first, to protect the house as a whole, and, secondly, to indicate leakage or a short circuit in the wires and fittings.

As Mr. Still in paragraph 2 of his letter refers to the Board of Trade, I shall be most willing to submit the point to their electrical inspector's decision, and thus settle the matter once and for all in a friendly way; and I hope, as he has put forward such a suggestion, he will adhere to it all the more, as, so far as can be seen, he is alone in his objection to the fuses in question.

My letter made it, as I was fully aware, sufficiently clear to him who the writer was, and my adopting a *nom de plume* was entirely due to modesty on my part, and not to a wish to avoid criticism or other consequences.

Safety Fuse.

I fail to see the force of Mr. Percy Still's argument when he maintains that a second D.P. cut-out is an unnecessary weak point in the wiring.

I take it from the company's own Rules, that before a supply be given, all wiring, fittings, &c., shall be passed by the company's inspector. Is it not, then, his duty to see that the fuses are making good contact, and are properly adjusted.

Further, nine contractors out of ten supply consumers with spare fuses and leave instructions for inserting such; and it is invariably the rule, that should anything go wrong with the installation the consumer sends for the contractor or nearest electrical engineer to rectify the fault.

Most supply companies require the consumer to provide a D.P. main switch, which is placed in an accessible position. Should the handle or other working parts of switch get broken, or out of order, and the switch have to be removed for repairs, the workman has either to make application to the supply company for one of their servants to remove the fuse from their box, or is obliged to work on live wires, standing a good chance of blowing the company's fuse, and may be having to pay a renewal fee of 10s. 6d.

Had there been a double-pole fuse on the consumer's side, alterations and repairs could be carried out without trouble or inconvenience to either party.

J. T. Booth.

January 26th.

The Amazon Cable.

There appeared an article in your last number headed "Amazon Cable." Surely the writer of the article is rather hasty in criticising the financial position of the Amazon Company.

No doubt the management have had to cope with great difficulties, and being a pioneer company, this is to be expected. The following extract from the article is important, suggesting how difficult it was to obtain any accurate knowledge of the river and its bed.

"These conditions, if they cannot be escaped, must always be inimical to the life of a cable, and it is a question, had the survey been extended over at least a whole year, during which time the effect of the various seasons could have been watched, if all the difficulties could have been avoided."

I was fortunate in accompanying this expedition, and can agree with the writer's suggestion above quoted, and am of the opinion that one might spend several years on the Amazon studying the climatic influences upon the river, and endeavouring to ascertain the true state of the bed without coming to any definite conclusion.

In my opinion the cable itself is the best indicator of the state of the bed of the river; snags soon make an impression upon it and rocks will soon wear it through. When one has found where this occurs, the only chance remaining is to try another quieter spot nearer the bank, where the cable will have more chance of reposing in peace.

Passing, however, to the financial side of the question, I quote again from the article:

"It was, however, stated by the chairman of the company at the second ordinary general meeting, that the first four and a half months traffic resulted in a return of £5,224, but as the cables were working throughout the whole length for only about three months, it would appear that the yearly traffic would work out at about £21,000, or £15,000 less than the receipts estimated before the opening of the cable."

This is assuming that the traffic will not increase; there is, however, no reason why the traffic should not considerably increase. The inhabitants of the towns are very enthusiastic, and quite recognise the great advantages of telegraphic communication, and will, no doubt, avail themselves of it.

Trade will develop and increase, and this will necessarily add to the number of messages sent.

It is, I think, scarcely fair to go into figures at present; after all, a trial extending over four and a half months is not sufficient to give an adequate idea of the future business of the company.

I am convinced there is plenty of traffic, and that the traffic will increase; moreover, I see no reason, providing the company can once get their cable laid in suitable position, why the proposed 10 per cent. should not be earned.

After all, the cable is not in a very bad state. There are in all over 1,300 miles, and of these 1,300 about 900 are giving no trouble—in fact, the difficulties to be encountered are concentrated upon a comparatively short length of cable.

A. E.

January 23rd, 1897.

Re Electric Light in Collieries.

In your "Note" under this heading you say you are informed that the Ocean Colliery Company have bought about 10,000 *electric hand lamps, which can only be opened by means of special apparatus.* I was about to start rejoicing over electrical progress and probabilities, when it occurred to me that a special apparatus for unlocking to open, applied (to my knowledge) to *an oil* lamp ignited only by electricity, and so I wondered whether a *bona fide* electric hand lamp or an electrically ignited oil or spirit lamp has been the one referred to. Can anyone enlighten a poor ignorant?

Battery Man.

LEGAL.

Taylor & Son *v.* London and South-Western Railway Company.

This case came on in the Queen's Bench Division on 15th inst. The plaintiffs, electric launch and boat builders at Chertsey, claimed £130 damages for injuries alleged, says *Transport*, to have been sustained by an electric launch in course of transit between Chertsey and Manchester. The railway company's defence was, that any injuries which had happened were caused by the improper packing in the launch of some accumulators containing sulphuric acid and water. The conditions in the consignment note signed by plaintiffs set out *inter alia* that the company would not be liable for any loss or damage resulting from goods not being properly protected by packing, also that in the case of goods consigned beyond the limits of the company's free delivery, their responsibility would cease when the goods had been handed over to another carrier. The company contended that this latter clause absolved them from liability, because they had handed over the launch to the Midland Railway Company at Brent Station in good condition. The company also pleaded that the mixture of sulphuric acid and water constituted "dangerous" goods within Section 105 of the Railway Clauses Act, 1845, and that the nature of the liquid not having been marked on the outside of the vessels, and written notice not having been given to the company, the contract for carriage was rendered void. Plaintiffs alleged that on arrival at Manchester the sides of the launch were stove in, and that the two trucks on which it was carried were not properly coupled. In summing up, his Lordship (Mr. Justice Mathew) said that if it was true that the planks had been stove in, no doubt the launch must have been roughly handled. As to the truth of that allegation, on the one hand there was the uncorroborated evidence of plaintiff and his son, while on the other four witnesses were called who said they had carefully examined the launch and had found no traces of broken planks. In deciding between these two conflicting stories it was most important to consider the circumstantial evidence. A significant fact was, that in the plaintiffs' first letters to the company no mention was made of broken planks. In reply to questions, the jury found that the planks were not broken when the launch was on the defendant company's railway; that the liquid from the accumulators was dangerous; that the station master at Chertsey was not informed as to the nature of the liquid, and considered it not dangerous; and that the damage was caused by the insufficient packing of the accumulators. On these answers his Lordship gave judgment for defendants.

H. S. Clement *v.* M'Lachlan M'Donald.

This action came on for hearing at the Edinburgh Court of Sessions, before Lord Stormonth-Darling, last week. Hugh Sprott Clement, manager, British Patents Company, 121, West Regent Street, Glasgow, sues Robert M'Lachlan M'Donald, electrician, Strathtay, Perthshire, for a statement of accounts connected with an invention relating to primary electric batteries, and of his whole intromissions with the assets derived from the working, sale, or hire of the invention, so that the balance due to the pursuer may be ascertained. Alternatively the pursuer concludes for £1,000. The pursuer founds upon a letter, dated February 19th, 1896, under which the defender assigned to him one twenty-fourth share in the patent "for services rendered and other valuable consideration." The defender says that the letter was granted upon the representation that the pursuer had obtained a purchaser for the patent, and on the condition that the agreement should only become operative upon the completion of the purchase. Next day the pursuer stated that the purchaser would not complete the bargain, and it is maintained that the agreement thereby came to an end. The record was closed, and the case was sent to the Procedure Roll.

BUSINESS NOTICES, &c.

Aluminium and Calcium Carbide.—The current prices of the British Aluminium Company, Limited, for aluminium and its alloys, and of the Acetylene Illuminating Company for calcium carbide turned out at the Falls of Foyers are interesting:—

Pure aluminium	(notched bars)	£155 per ton.
" "	(sheets and plates, Nos. 1 to 20 S.W.G.)	£205 "
" "	(Wire ditto)	£240 "
" "	(Solid drawn, seamless tubing, basis price for tubes 1½ to 4 ins. outside diameter by 14 S.W.G.)	£280 "

To obtain the relative cost of aluminium sheet, wire, tube, rod, &c., to copper, brass, and steel sheet, multiply the cost per lb. of the copper sheet by 3·3, brass sheet by 3·1, steel sheet by 2·9, and tin sheet by 2·8.

Aluminium Bronze.	Grade A.—10% Al.	77s. per cwt.
" "	" B.— 7½ "	75s. "
" "	" C.— 5 "	70s. "
" "	" D.— 2½ "	67s. "
Ferro-aluminium	... ...	£37 per ton.

Calcium Carbide.

The Acetylene Illuminating Company, Limited, E.C.

In quantities of not less than 1 ton	£28 per ton.
" from 5 cwt. up to 1 ton	£30 "
Sample drums (56 to 112 lbs.), drums included ...	5d. per lb.

F.o.b. Foyers.

Discounts for contracts on application.

Bankruptcy Proceedings.—The first meeting of creditors will be held on February 3rd at 11 a.m., at 23, Colmore Row, Birmingham, and the public examination at 2 p.m. on the same day at the Birmingham County Court, in the failure of W. R. Ridings, electrical engineer, of Albert Street, Birmingham.

Calendar.—Messrs. Dorman & Smith have issued a very serviceable 1897 calendar, which is a thick highly glazed hanging card about 15 inches by 14 inches, the edges being protected by a metal binding.

Casings.—Messrs. Kenyon and Moulding of Montague Street Saw Mills, Blackburn, have issued a revised price list of electric light wire casings and covers which are made from the best well-seasoned canary whitewood.

Lists.—The Edison & Swan United Electric Light Company, Limited, has issued a couple of neat illustrated price sheets of the "Ediswan" switchboards, and shop window brackets for inside lighting.

Electrical Wares Exported.

WEEK ENDING JAN. 12TH, 1896	£	s.
Algoa Bay	18	0
Amsterdam	100	0
Auckland	8	0
Buenos Ayres Teleg. cable ...	340	0
Brisbane Cable ...	1,090	0
Calcutta	510	0
Colombo	20	0
East London	3,069	0
Flushing	36	0
Geracator. Tele. mtl. ...	55	0
Gothenburg	34	0
„ Teleg. mtl.	1,353	0
Hamburg. Teleg. mtl.	65	0
Melbourne	297	0
Revae	70	0
Stockholm	33	0
Singapore	12	0
Wellington	114	0
Total	£7,224	0

WEEK ENDING JAN. 19TH 1896.	£	s.
Algoa Bay	250	0
Auckland	77	0
Cape Town	98	0
Calcutta	403	0
Gothenburg. Teleg. cable	220	0
Hong Kong	20	0
Malta	22	0
Melbourne	72	0
Port Natal	175	0
Sydney	40	0
Trinidad	23	0
Yokohama	36	0
Total	£1,436	0

WEEK ENDING JAN. 12TH, 1897.	£	s.
Albany	49	0
Alexandria. Teleph. mat.	82	0
Amsterdam	50	0
Auckland	77	0
Bombay	511	0
Bremen	50	0
Brisbane	13	0
Calcutta	390	0
Colombo	23	0
„ Teleg. mtl. ...	265	0
Durban	70	0
East London	190	0
Flushing	300	0
Freemantle. Teleg. mtl.	1,484	0
Madras	12	0
Malaga	134	0
Melbourne	438	0
Perth	173	0
Port Elizabeth	15	0
Revae	30	0
„ Teleg. mtl. ...	845	0
Rotterdam	95	0
Santander	250	0
Singapore	34	0
Sydney	419	0
Yokohama	316	0
Total	£6,215	0

WEEK ENDING JAN. 19TH, 1897.	£	s.
Amsterdam	88	0
Antwerp	13	0
„ Electric fuses	124	0
Auckland	158	0
Barcelona	15	0
Barranquilla. Teleg. mat.	352	0
Bombay	64	0
Buenos Ayres	54	0
„ „ Teleg. wire	150	0
Cape Town	88	0
Calcutta	27	0
Colombo	94	0
Durban	1,134	0
East London	57	0
Flushing	10	0
Hobart	27	0
Hong Kong. Teleph. mat.	90	0
Launceston	485	0
Melbourne	22	0
„ Teleg. wire	170	0
Passages	238	0
Port Elizabeth	345	0
„ Darwen. Teleg. mat.	129	0
Shanghai	465	0
Revae	7	0
„ Teleph. mat. ...	60	0
Santos	40	0
Singapore. Teleph. mtl.	14	0
Smyrna	67	0
Sydney	129	0
Syra	42	0
Trinidad	55	0
Wellington	256	0
Total	£5,075	0

Foreign Goods Transhipped.

Bankok	90	0
Melbourne. Teleg. mtl.	200	0
Total	£290	0

Dissolution of Partnerships.—Messrs. S. G. Trehearne and F. H. Gurney, hitherto carrying on business as electrical engineers at 115, Fenchurch Street, London, under the style of S. G. Trehearne & Son, have dissolved partnership by mutual consent. All debts will be attended to by S. G. Trehearne.

Messrs. Turner, Bros. & Crowther (W. Turner, E. Turner, and D. Crowther) hitherto carrying on business as electrical engineers at Byron Arcade, Huddersfield, have dissolved partnership by mutual consent. Debts will be attended to by W. and E. Turner.

Gas.—Seeking for a leakage with a light caused fire and explosion at 10, Ducie Street, Brixton, on 20th inst.

A gas explosion occurred on 20th inst. at one of the engineering shops of the London & South Western Railway, at Nine Elms. A good deal of damage was done, and a lad injured.

At Redcar gas works on 19th inst. a serious gas explosion occurred. Two men were seriously injured and extensive damage was done.

On 18th inst. there was a gas explosion at the Cape of Good Hope Hotel, Broseley, the premises being partially wrecked.

Early on Wednesday morning a serious gas explosion and fire occurred at Parliament Hill Road, Hampstead.

Partnership Notice.—Messrs. Wheatley Kirk, Price and Goulty have just admitted Mr. Ernest Sherley-Price into partnership. The firm now consists of the following members:—Mr. Hy. Sherley-Price, Mr. W. R. Goulty, Mr. S. Sherley-Price, Mr. E. Sherley-Price.

Liquidation Notices.—A general meeting of the Keighley Electrical Engineering Company is to be held at Alexandra Works, East Parade, Keighley, on February 26th, at 7 o'clock p.m., for the purpose of hearing an account of the winding-up proceedings by Mr. A. D. Smith, liquidator, and of transacting business usual at such meetings.

Notice is filed in the *London Gazette* to the effect that creditors of the Acme and Immisch Electric Works, Limited (whose debts have not already been sent in to Messrs. E. Wilding and James Gray, the liquidators), are required to send their names and addresses, and the particulars of their debts, &c., to Mr. E. Wilding, 2, Clement's Inn, Strand, London, on or before February 3rd.

Manchester Battery Plant.—The Chloride Electrical Storage Syndicate, Limited, have issued a beautifully got up reprint of the description which appeared in the ELECTRICAL REVIEW of the Manchester accumulator stations laid down in connection with the electric lighting extensions. There are four full page photographs of the battery rooms showing the cells.

Mica.—Messrs. Bergtheil and Young, who are sole agents in this country for the Mica Insulator Company, of Schenectady, inform us that the Schenectady Railway Company have given the following opinion or testimonial of the use of micanite on their lines. They state that:—"In March, 1894, you put a full body and slot insulation of micanite on one of our Edison No. 16 street car armatures, and the same was wound at once and put in service, and has been pretty steadily running ever since, the car having made over 50,000 miles. The armature has never given us any trouble in 'body grounds' since it started, although it is of the 'ring' type, and is not protected by the motor frame, it being open to snow, slush or water, from the wheels. The wiring on this armature has just been burned out by a severe and continued overload, so heavy as to not only char the insulation of the wire, but to melt some of the wires themselves. On stripping off the wires, we were surprised to find the insulation of body and slots in apparently good order; and after fully stripping and testing, we find it absolutely perfect, mechanically and electrically, and are now re-winding it, having done nothing to the insulation but to give it a coat of varnish and bake it. While the full micanite body insulation costs several times more than our previous method of cloth, mica and paper, the results in freedom from armature 'body grounds,' and the ability to re-use the insulation indefinitely are points that will make us consider the use of micanite as essential in all our work for the future."

Oil Cans.—Messrs. T. F. Braime & Co., of Hunslet, Leeds, inform us that they have again secured the Admiralty Contract for supplying the whole of the British Navy with their seamless patent steel oilcans for the next three years ending December 31st, 1899.

Personal.—In respect to an announcement made in these columns last week we understand that Mr. H. C. Warburg, late Manager of London House Wiring Department (Messrs. Crompton and Co., Limited), has entered into a partnership with Mr. J. D. Dymond, and that the style of the firm will be Warburg, Dymond, and Co. The firm has purchased the goodwill and business of the London House Wiring Department of Messrs. Crompton & Co., Limited. We wish the firm success.

Photography.—"Everybody's Guide to Photography," is a small popularly written book published by Messrs. Saxon & Co., Bouverie Street, E.C., giving up-to-date information and practical instruction in the various branches of photography.

River Plate Electrical Imports.—The imports of electrical goods for the first nine months of 1896, as compared with the corresponding period of 1895, are valued, says the *Review of the River Plate*, as follows, in gold dollars:—

	1896.	1895.
Galvanised iron wire	$638,646	$323,004
Dynamos (21)	6,446	—
Materials for electric light ...	111,233	87,937
Cables and wire	31,612	—
Fittings for gas and electric light	61,933	45,534
Telephone material	7,732	2,134
Telegraph material...	35,742	10,445
	$893,345	$469,054

The above figures show how the electrical business is progressing there.

The "Helios" Arc Lamp.—The International Electric Company, of 55, Redcross Street, who are the sole agents for this type of arc lamp, announce that in consequence of the increased output, and by the further economising of labour, through the introduction of new labour-saving machinery, the Helios lamp will now be supplied at a considerably reduced price. The company keeps a large stock in London.

The "Yost."—This Typewriter Company were last week awarded two more gold medals, one at Bristol and the other at Manchester.

ELECTRIC LIGHTING NOTES.

Bournemouth.—The Town Clerk has reported to the Council that, in accordance with instructions, he had communicated with the electric light company, in order to ascertain whether, and upon what terms, they would be disposed to sell their undertaking to the Council, and he had received a reply indicating their willingness to enter into negotiations. It was determined to refer the matter to the whole Council, sitting in committee.

Ayrshire.—An electric lighting installation for the Newton Brewery Buildings has been carried out by the Faraday Electrical Engineering Company, Limited, and consists of one 22 B.H.P. Acme steam engine with a dynamo capable of giving 15 kilowatts. The lighting comprises 100 32-C.P. lamps, as well as a few 50 C.P. The bar is lighted either by five incandescent lamps of 50 C.P. each, or by two arc lamps of 1,500 C.P. each. In the yard are two arc lamps of 3,000 C.P. each. Switching arrangements have been made in the bar, so that the lighting can be carried out from either the Corporation electric supply, or from the dynamo.

Bedford.—The Markets Stall-holders' Committee have elaborated a scheme, whereby they undertake to use 200 16-C.P. lamps, for which they offer 3d. per lamp per night. It is estimated that the rentals should yield £130, showing a total profit for the authority of £70 12s. 9d. per annum. It is suggested that the installation could be arranged by means of two distributing poles in St. Paul's Square Market and one pole in Silver Street Market, which could be connected from a joint box and overhead twin wires to each stall every Saturday by an employé of the Authority.

Burntisland.—The question of introducing the electric light for harbour and dock purposes has come to the front here. The Gas Commissioners have had the matter before them, and in view of the fact that a serious loss in revenue would arise from the superseding of the gas supply by the introduction of the electric light at the docks, the Commissioners have appointed a committee of their number to confer with electric lighting firms as to the cost of providing an installation, and to report to a future meeting.

Bristol.—The Electrical Committee has resolved to make a reduction in the charges for energy supplied for motive power and for heating. In future there will be a fixed charge of £6, and 2d. per unit for the current consumed, instead of the present charge of 4d. per unit, subject to a discount.

China.—It is stated that an electric light company is to be established at Hangchow, permission for same having been granted by the governor.

Cork.—A proposal by Messrs. Porte, Sikes & Co., to act as consulting engineers in connection with electric lighting of the Union buildings was before the Guardians last week. The question as to whether the electric light should be introduced or not was referred to a special committee, and the firm mentioned are to appear before that body.

Glasgow.—The Electric Lighting Committee have declined the proposals of the Electric Lighting Extension Syndicate *re* penny-in-the-slot meters.

A member has given notice that at the next Trust meeting he will move that after the expiry of the current financial year, the administration of the electric lighting department of the Corporation be under the control of a separate general committee, instead of being, as at present, controlled by a sub-committee of the committee having control of the gas works.

Hampstead.—The Vestry, acting on the recommendations of the Committees, have been raising the salaries of employés in all departments. In the electrical department the recommendations of the Lighting Committee, which were that the salary of the chief electrical engineer, Mr. Geo. H. Cottam, be increased from £300 to £400 per annum, also that the salaries of the assistant electrical engineers, Messrs. H. W. Woodall and H. Moreton, be increased from £117 to £130, have been adopted.

Hanley.—The Electric Lighting Committee recommends that application be made to borrow £15,000 for extensions to the electricity works during the next two years. In the first year of their existence they asked the Local Government Board to sanction the borrowing of about £24 000. That was found to be insufficient, and they asked for a further sum which made up a total of £46,110. Out of this, the Committee had expended on capital account £42,145. With regard to the increase of engine power, and the extension of the system, he said that in 1895 they sold 180,469 units at 6d. per unit, while last year they sold 247,881 units at 5d. per unit. The revenue last year from electricity supply was £4,192, and the receipts from meter rents were £106, being half as much again as in 1895.

Huddersfield.—The Electric Lighting Committee has instructed the borough electrical engineer to report upon the schemes of the Electric Lighting Extension Syndicate, Limited, and the Electric Free Wiring Syndicate, Limited. It has been reported to the Committee that in January, 1896, the number of consumers was 280, and the number of lamps connected was 20,889; now there are 385 consumers and 28,983 lamps. The units metered in 1895 were 237,800, and in 1896 317,648, or an increase of 25 per cent.

Islington.—We understand that Mr. Lambert, the chairman of the Electric Lighting Committee, intends proposing that the St. John's Road Workhouse and Infirmary—whose lighting bill now amounts to £900 or £1,000 per annum for gas—be lighted by electricity. If this is done, and the supply taken from the Vestry's mains, it should be a grand help to the electric light undertaking.

The Vestry wants an assistant fitter for the electricity department. See our "Official Notices" for particulars.

Kingston-on-Thames.—Mr. Preece, who has acted as consulting electrical engineer to the Local Authority, has submitted to the Lighting Committee a statement of the expenditure and liabilities in respect of works of electric lighting on capital account. The amount of expenditure and liabilities was £29,497 8s., and the loans at present authorised and received amounted to £23,772, leaving the sum of £5,725 required to be borrowed. The borough electrical engineer has also submitted an approximate estimate for the extension of buildings and plant at the central station, and the extension of mains; the total amount required to be expended under these headings being £14,242 10s., which brought the proposed estimated expenditure up to a total of £19,967 18s. The Committee recommended the Council, through the General Purposes and Finance Committee, to authorise application to be made to the Local Government Board for sanction to the borrowing of a further sum of £20,000 for electric lighting purposes. It was also recommended that the borough electrical engineer (Mr. J. E. Edgcome) be the consulting engineer in regard to the carrying out of the proposed work. Subject to the Council's approval, the Committee had decided to extend the electric mains along Richmond Road and along Albany Park Road, at an estimated cost of £880; and also to lay an electric cable to St. Raphael's Church, Portsmouth Road.—Councillor J. J. Collings, in moving the adoption of the report at the last meeting of the Council, said the Committee felt that they had arrived at a stage when the lamps they already had connected left practically no spare power, and it was absolutely necessary to provide additional capital if they were to proceed with any success. He believed that if the money was spent they would, in two years, have an undertaking which would be a source of revenue to the Corporation.—Councillor Nuthall seconded. The Committee's report was adopted, with only four dissentients.

Lee.—Last week, the General Purposes Committee reported that they had considered the notice of the Blackheath and Greenwich District Electric Lighting Company as to the provisional order, and recommended that the Board approve of the electric light throughout the district. Several members having spoken in favour of an engineer being appointed, the recommendation of the committee was agreed to.

London, W.—The London County Council has agreed to lend the St. James's Vestry £3,850 for electric lighting purposes.

Margate.—One would have thought that so popular a resort as Margate would have adopted electric lighting long ago. The matter has been thought about by companies on several occasions, but nothing has come of the proposals. Now, however, the General Purposes Committee has been going into the question, and a proposal was made at its meeting on Tuesday last week to appoint Messrs. Harrap, Hewitt and Duffield to prepare plans for an installation for street lighting, at a cost not exceeding £15,000, their commission for preparing plans to be at the rate of 1¼ per cent. It was stated that the matter must be proceeded with at once, and application made to the Local Government Board to borrow before July, or else someone else could step in. A member suggested that no figure be stated, but that the firm draw up its report as to the probable cost of an installation. It was, however, decided to defer the matter for a fortnight, so next Tuesday the matter will, doubtless, come up again.

Newhaven.—The District Council has decided to adhere to the Council's decision to oppose the granting of a provisional order to the Rottingdean Electric Lighting and Power Company, Limited, the grounds of opposition being that it was undesirable to grant a monopoly.

Newington.—The Vestry has received a letter from the Board of Trade notifying the receipt of three petitions against the granting of the electric lighting order to the Vestry—one from the Newington and Walworth Ratepayers' Association, the second from a body of ratepayers, and the third from the Brush Company. The matter has been referred to the Electric Lighting Committee.

Poplar.—The Board of Works has appointed a Special Committee for the purpose of considering the advisability of transferring to the County of London and Provincial Brush Electric Lighting Company the provisional order which the Board has itself obtained for lighting the district by means of electricity.

Sheffield.—On 22nd inst. the electric light installation, constructed at a cost of £1,000 for the Masbro' Co-operative Society at their central stores, was formally brought into use. The installation comprises 203 16-C.P. lights, and seven Jandus arc lamps. The dynamo is the Edison-Hopkinson compound wound-bar armature type, by Messrs. Mather & Platt, capable of giving 160 amperes at 105 volts. A Robey gas engine, capable of giving 27 effective horse-power, drives the dynamo. The installation, wiring, fitting, &c., is by Messrs. John Dewhurst & Co., of Sheffield. The whole of the work has been carried out by the Co-operative Wholesale Society, Manchester, under the superintendence of their electrical engineer, Mr. Henry Shaw.

Stirling.—The Town Council has adopted Prof. Kennedy's report on the electric lighting of the town, and the matter has been remitted to a committee to consider with reference to the districts to be supplied, and how far the work should be carried out at once.

St. Pancras.—At last week's Vestry meeting Mr. Cox, chairman of the Electricity Committee, stated that a claim had been received from Messrs. W. T. Henley's Telegraph Works, Ltd., for the sum of £2,419 7s. 8d., extras over their contract of £17,000 for laying electric mains. The committee acknowledged extras to the amount of £582 15s. 3d., but had a letter from Messrs. Henley's solicitors claiming £2,743 11s. 8d., stating their instructions were to take proceedings for recovery at the expiration of a month. The committee recommended, on the advice of the Vestry's solicitors, Messrs. Cunliffes & Davenport, to apply at once to stay the action under the Arbitration Act, 1889, and to make a tender to Messrs. Henley of £582 15s. 3d.—Agreed.

Toronto (Canada).—We learn that this town was in darkness on the night of the 21st inst., through the electric lighting company's plant having been destroyed by fire.

Wallasey.—These works, which have been erected in Sea View Road, Liscard, will be opened on the 29th inst. by Mr. W. G. Ellery, chairman of the Gas, Water, and Electric Supply Committee.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Brighton - Rottingdean Seashore Railway.—The Works Committee have disapproved the plan submitted for the new jetty station for the Rottingdean Electric Railway, to be constructed on the eastern side of the Paston Place groyne, in substitution of that washed away by the great December gale.

Cable Tramcar Accident.—On Saturday morning last, a cable car, whilst proceeding on the Handsworth route, Birmingham, was suddenly brought to a standstill near Hockley Brook, the sudden stoppage nearly overturning the car, throwing three of the outside passengers into the roadway. Fortunately they escaped with nothing more than a severe shaking up.

Clontarf.—The contractor for the erection of the Clontarf electric power station, which is to supply the motive power for the new electric tram system from Clontarf to Annesley Bridge on the North Strand Road, begun work last week.

Dover.—There has been an alteration in some of the tenders accepted, and the amounts thereof, in connection with the laying of the tramways. Mr. Briggs, of Blackburn, stated that he had made an error of 1s. per superficial yard of the paving, making the price £9,729 odd, which shows a difference of about £900. The additional price was allowed. Messrs. Rowell, Stewart, Kelman & Co., stated they were unable to supply the rails at the estimated price, and they suggested that the contract be given to Messrs. Dick, Kerr & Co., at an increase of £130 odd. This was agreed to by the Town Council last week, several members demurring at the rise in the prices after the contracts had been given out.

Europe.—The progress of electric traction in Europe during the past year has not, says the *Financial News*, been commensurate with the high hopes entertained by its advocates. According to a report of United States Consul Moore, at Weimar, the aggregate mileage of European railways built for electric operation during 1896 reached only 125 miles, the total increasing from 435 miles to 560 miles. "Nearly half of this aggregate is found in Germany, which has 252 miles of line; France follows with 82 miles, Great Britain is next with 66 miles, Austria-Hungary is fourth with 44 miles, Switzerland has 29 miles, Italy 24, Russia, Belgium, Spain, and Servia have from 6 to 18 miles each, and the other States less than five miles each. The number of cars increased during the year from 1,236 to 1,747, or over 40 per cent.—which indicates a great addition to the traffic, and should dissipate any doubts that may be entertained of the system's growing popularity. The overhead trolley, used on 91 of the 111 lines, shows that the roads have been built with a view to economy, though the other 11, which use the underground conduit (in addition to eight with accumulators) may possibly fare best in the end. The progress of electric railways on this side of the Atlantic is evidently slow. The United States must continue to be far ahead of us in this kind of development, because she has several Europes, in effect, in which to work it out."

Halifax.—The Tramways Committee have appointed a sub-committee to inquire into the various means of traction. Though the matter has not yet been fully discussed, says the *Halifax Guardian*, there is little doubt that the most popular means of traction among the members of the Town Council and the public generally is electricity. The desirability of adopting this system is considerably emphasised by the necessity for obtaining a "day load" on the electric lighting plant, in order to put the installation upon a sound financial basis. At present, the machinery at the lighting station is fully employed for only about four hours per diem. In winter, the average output is something like 2,000 units per day, but the machinery is capable, if continuously working, of turning out five times that quantity, at an additional cost of about 1½d. per unit for the extra consumption of fuel, &c. "One difficulty in regard to the use of the electric lighting plant for the supply of electricity for tramways is that from about 5 p.m. to 10 o'clock, when the trams are likely to be most required, the electric lighting machinery is working at its maximum. Thus it is obvious that some means must be devised for increasing the output during this portion of the day. Mr. Wilmshurst, the borough electrical engineer, however, thinks he can get over this difficulty by adding a large battery of accumulators which could be sufficiently charged during the hours the trams are not in use, to keep them running independently when the full power of the machinery is required for lighting purposes. This method would afford the dual advantage of being able to keep the cars going in case of a temporary breakdown at the works, and of making it possible to shut down the works during the summer nights. It is estimated that the carrying out of this scheme would enable the Corporation to supply current for trams at less than 2d. per unit, while effecting a substantial reduction on the charges to the public for lighting purposes. The capital cost on the alteration of the existing buildings and provision of additional plant is estimated at about £8,000. The cost of providing separate plant and buildings would in all probability amount to £40,000, and there would be a proportionate increase in the cost of working."

Jungfrau Mountain Railway.—The *Electrical World*, N.Y., gives abstract of a recent official publication about this bold undertaking, from which it appears that the undertakers have definitely come to the conclusion that electric power is the best to use on mountain railways. From experience it has been found that the electric lines cost more to construct, but that the cost of working is always very materially less than with steam locomotives. The chief disadvantage of electricity is that the installation must be designed to meet the maximum demand, which makes the first cost great. The traffic on such lines varies very considerably. The slow speed on mountain lines requires a very large reduction of speed, which involves considerable loss of power in the gearing; worm gearing being excluded, because it is not adapted for continuous work or large powers. The plan considered best for mountain railways is to use three-phase currents sent to motors on the car, and the present railway is designed on these lines. The upper end of the line reaches a point 73 metres below the top of the snow covered mountain, from whence the rest of the ascent is made by means of an elevator. Electric energy will be used in the construction of this line, boring tunnels, lighting, &c. The steepest gradient is 25 per cent.; the total rise is 2,102 metres, and the total length 12·26 km. The time taken in the ascent will be 100 minutes; the maximum speed will be 8·5 km. per hour, and the maximum power required to work the line will be 1,400 H.P. It is estimated that the undertaking will pay a dividend of 6·8 per cent. The work of construction commenced on August 1st last year, and it is thought that the first section will be in operation by August 1st next year, after which the construction of the large tunnel will begin.

Middlesbrough.—In view of the special meeting of the Middlesbrough Town Council held on Wednesday, Mr. J. Clifton Robinson, C.E., managing director of the Imperial Tramways Company, Limited, issued a circular letter, restating the position of the question of providing an electric tram service to the district. The Imperial Tramways Company had submitted to the Corporations of Middlesbrough, Stockton-on-Tees, and Thornaby detailed proposals in print, the intention being, in connection with the proposed extension and improvement of the lines in Middlesbrough, to acquire the tramway lines in other townships, and to combine the three systems in one, so giving cheap and frequent through communication between the towns, as well as an improved local tramway service in each place.

Motor Cars.—The Electricity Committee of the St. Pancras Vestry, considering the probable extensive demand for current to charge the accumulators for motor vehicles, hold that every facility should be granted to encourage this class of consumer, having regard to the fact that the charging would be carried out during the hours the central stations were running on a light load. This would considerably enhance the earning capacity of the plant and consequent profit to the Vestry. Hence, subject to special regulations as to the hours of charging, the committee have fixed the price for charging accumulators at either of the Vestry's central stations at 2d. per unit.

The Chiswick District Council has decided to adopt the steam motor car for the purposes of the collection of dust and house refuse. Before contractors' tenders for dust collection were accepted, it was resolved to instruct the surveyor, Mr. Arthur Ramsden, to report as to the saving likely to be effected by the purchase for dust collecting purposes of a steam motor tip-car, a design for which, prepared by Mr. John I. Thornycroft, had been submitted by the Steam Wagon and Carriage Company, of Chiswick. This could be purchased for £350. The surveyor reported that if two of the motor cars were purchased at the price stated, and the payment spread over three years, he estimated that there would be an immediate saving of £50 a year, and that at the end of the three years the saving would be about £250 per annum. The Council has decided to purchase two of the motor cars on the terms suggested, to be delivered on March 31st next.

River Plate.—Mr. Charles Bright, of Buenos Ayres, is putting down the trial electric tram line in the Calle Las Heras to Palermo Park. This is being done to let the authorities see the different forms of trolley wiring. The company has asked the Municipality for a concession, should the above trials prove satisfactory, for a line from Paseo de Julio, Centro America, Las Heras to Santa Fé Road, to Palermo down towards the lower Belgrano Road, with branches to the Hipodromo Argentino and Tiro Federal. The trials are to last three months, and the *Review of the River Plate* thinks that in that time the authorities should become convinced of the benefits to be enjoyed from the system.

TELEGRAPH AND TELEPHONE NOTES.

Rubber in Brazil.—Consul Kanthack, in a report to the Foreign Office on the trade and commerce of Maranham for the year 1895-6, says:—"There is not much to be said of a satisfactory nature. Emigration to the rubber districts of Para and Amazonas continues, and those who remain are as indolent as ever. The population is large enough and poor enough to ensure sufficient production, but it is far from being a working population, hence little or no progress is made. One gleam of hope has appeared in the reported success of exploration for rubber; about half a ton has come to market, and is apparently of fair quality, and larger quantities are said to be on the way, while the district continues to be opened as quickly as workpeople can be found to do so, and prospects are said to be most encouraging."

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1895 ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Maranham-Ceará	Dec. 2nd, 1896 ...	...
St. Croix-Trinidad	Nov. 30th, 1896 ...	...
Hong Kong-Macao	Jan. 5th, 1897 ...	...
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Salisbury-Umtali	July 11th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...
Saigon-Bangkok ...	... Jan. 22nd, 1897	... Jan. 23rd, 1897.

From February 1st the Roumanian Administration reduce transit rate for Bulgarian and Russian (European system) correspondence to 3 centimes.

Australian Landlines.—We understand that in Western Australia efforts are being made to improve the system of landlines by duplicating a portion of the old line which follows the coast. The Hon. Mr. Thomas Playford has pointed out that this line is subject to interruption, due to the dampness and atmospheric troubles to which a long line near the coast is said to be liable. Similar difficulties are met with in the landlines in Ceylon, and the following hint given by the Cingalese Press may be useful in Western Australia:—"One point may be touched upon, however, by which marked improvement in the insulation of circuits may be looked for. The porcelain or stoneware cups, known as 'insulators,' which prevent the electric current, on its way to a distant station, from leaking down the posts, have been found often to crack spontaneously, especially near the sea. A number of such specimens of old China seriously impair the electrical efficiency of a telegraph circuit. Lately, we think, the cause has been found. The iron stem was secured inside the cup with a hard setting of cement. Either the salt air or the constituents of the cement has oxidised the iron, and the force of expansion upon oxidation has been so irresistable as to burst the cups right through, a very minute crack being the first symptom of the disease. A soft cement has now been adopted, and in time it is hoped to obviate these unlooked for and unwelcome occurrences.

Commercial Cable Company Mortgage.—A mortgage has been filed, says the New York *Electrical Engineer*, with Register Sohmer for $20,000,000, given to the Farmers' Loan and Trust Company by the Commercial Cable Company, pledging all its telegraph properties, rights, privileges, and franchises, including those of the Postal Telegraph Company. The mortgage is given to secure an issue of 500 4 per cent. gold bonds and debenture stocks, which aggregates the sum of the mortgage.

Trunk Communication.—The Post Office authorities have issued a list of the charges for telephone trunk wire conversations from London (including Balham, Bromley (Kent), Croydon, Dartford, Deptford, Ealing, Epsom, Hammersmith, Kingston-on-Thames, Red Hill, Richmond (Surrey), Stratford-le-Bow, Streatham, Sutton, Sydenham, Tilbury, Wimbledon, and Woolwich), to the various provincial towns and cities to which communication is possible, by means of the trunk lines—supplemented, where necessary, by the system of the National Telephone Company. When the conversation is between a subscriber to an exchange of the National Telephone Company and a subscriber to a Post Office telephone exchange, in either direction, additional charges, which also apply, in either direction, to a conversation between a call office of the company and a post office, are made:—When the trunk wire charge for three minutes' conversation does not exceed 1s. 6d., 3d. for each period of three minutes; when the trunk wire charge for three minutes' conversation exceeds 1s. 6d., but does not exceed 3s., 4d. for each period of three minutes; when the trunk wire charge for three minutes' conversation exceeds 3s., 6d. for each period of three minutes.

Telephonic Charges.—Mr. J. C. Lamb, C.B, C.M.G., has written by direction of the Postmaster-General to the secretary of the Association of Chambers of Commerce, making the following statements with regard to the charges for ineffectual calls and time lost:—"With respect to the suggestion that no charge should be made for ineffectual calls, I am to say that every allowance is made in cases in which the failure is due to some fault or error in the service of this department; but, having in view the desirability of maintaining the efficiency of the service, his Grace regrets that he does not see his way to altogether forego the charges for calls which prove to be ineffectual owing to causes for which the subscribers are themselves responsible. The suggestion of the association that no additional sum should be charged for the time lost in securing reasonable conversation is understood to have reference to cases in which, although communication has been established between the offices of subscribers, the particular person with whom it is desired to effect conversation cannot attend immediately at the telephone. Special measures are being taken to ensure that subscribers shall in all cases have the full time for which they are charged, but it is not in the power of the Postmaster-General to allow the duration of a call to be reckoned merely from the moment when the attendance of a particular person can be obtained; all he can do is to place the service at the disposal of the subscribers for the full time for which payment is made."

The Commercial Cable Company.—According to the *New York Herald* of December 2nd, 1896, the gross revenue of this company for the previous year was $2,009,738; the working expenses $794,340, and the net revenue $1,215,393. As illustrating the progress of Atlantic telegraphy, it may not be amiss to give the following figures taken from the prospectus recently issued by the Commercial Cable Company when offering debentures for subscription. They relate to that company, and also to its allied company, the Postal Telegraph Cable Company:—

Postal Telegraph Cable Company.

Year.	Miles, poles and cables.	Miles wire.	Offices.	Messages.
1889	8,554	51,016	808	6,078,361
1890	11,142	67,751	1,050	7,380,000
1891	12,739	76,365	1,187	8,271,768
1892	13,363	88,646	1,412	9,335,291
1893	16,201	101,807	1,605	10,251,194
1894	17,727	108,636	1,759	10,965,509
1895	19,477	117,344	2,067	12,493,892
1896	—	—	—	—

Year.	Receipts.	Expenses.	Net earnings.
1889	$1,933,192 40	$1,599,798.71	$333,393.69
1890	2,505,438.43	2,024,239.57	481,198.86
1891	2,803,228.29	2,461,228 74	341,999.55
1892	3,187,678.26	2,697,934.47	489,743 79
1893	3,565,293.51	3,028,020.96	537,272 55
1894	3,754,233.07	3,157,651.13	596,581.94
1895	4,321,296.38	3,703,433.00	617,863.38
1896	—	—Estimated	586,000.00

Commercial Cable Company.

Year.	Net earnings.	Dividends.	Surplus.
1889	$ 959,931	$201,480	$758,451
1890	1,112,680	482,250	630,430
1891	1,085,324	540,120	545,204
1892	1,089,587	540,120	559,467
1893	1,057,746	613,376	444,370
1894	1,010,439	700,000	310,439
1895	1,215,398	700,000	515,398
1896 (Estimated)	1,180,000	800,000	Not finally ascertained.

Of this surplus, $3,000,000 has been expended in repayment of £600,000 6 per cent. debentures.

The Deutsche See Telegraphen Gesellschaft.—The following paragraph is now making its round through the daily Press—we suppose as a justification of the fact that the cable of the above corporation does not land in England on its way from Germany to France. There is no special reason why it should do so, but as it has been laid, and is to a great extent financed, by English companies, there should be a natural reluctance to pass by the shores of England without landing. We are astonished, however to learn that the reason adduced is the "refusal of the British Government" to give landing rights on the English coast. This is very unlike the course usually adopted in these cases; and were English Government officials at liberty to defend themselves in the Press, we have little doubt that another aspect would be given to this question:—"It is stated that, with regard to the new German-Spanish submarine telegraph cable, the original intention was to connect it with the larger Transatlantic telegraph lines on the south coast of England. If that had been feasible it would have been necessary only to lay a comparatively short cable from Borkum to England. The syndicate for forming a company to carry out this project had been arranged, but the British Government refused the requisite permission for the landing of the cable on our shores. There was then no alternative but to adopt the plan of laying the much more expensive cable to Spain, and that is the reason for the establishment of the direct cable between Emden and Vigo."

CONTRACTS OPEN AND CLOSED.

OPEN.

Boston.—February 8th. The Harbour Trust are prepared to receive tenders for an installation of electric light at the Harbour and Docks, Boston, Lincolnshire, consisting of steam engine, dynamo, switchboard, arc lamps and posts, mains, wiring, fittings, &c. See our "Official Notices."

Derby.—February 6th. The Corporation wants tenders for the wiring and supply of fittings for electric lighting of the Derby Technical College. Specifications, &c., from Mr. J. E. Stewart, the electrical engineer. See our "Official Notices" for details.

Fareham.—February 15th. The District Council want tenders for cables and conduits, for excavation, making good, and sundry house and public lamp connections. Consulting engineers, Messrs. Kincaid, Waller, & Manville. See our "Official Notices."

France.—January 31st. Tenders are being invited until January 31st next, for the contract for an installation of electric lighting in the Asile d'Aliénés at Saint Jvon (Seine Inférieure).

(*Contracts continued on page* 144.)

THE EXTENSION OF THE LIVERPOOL OVERHEAD RAILWAY.

At the last meeting of the British Association at Liverpool, Mr. S. B. Cottrell, the engineer and manager of the Overhead Railway, gave many interesting details of the extensions which were then in course of construction.

The southern extension, $\frac{5}{8}$ths of a mile long, has just been completed, it commences about 150 yards north of the original terminus of the railway, with a viaduct 250 yards long, crossing Sefton Street and the Brunswick goods yard of the Cheshire Lines Railway, a portion of the Dock Board Estate, and entering the hill side at the north-east corner of the Herculaneum Dock, and proceeds in a south-easterly direction to Park Road.

To meet the requirements of the Dock Board, their land is crossed by one span of about 200 feet, the main girders (which are of lattice type with parallel booms) being 220 and 225 feet respectively, and the whole of the span weighs about 212 tons.

Underneath where these big girders rest at the face of the tunnel, are casements for storing petroleum, belonging to the Dock Board, extending about 60 feet into the hill, and to distribute the weight of the span over these, a bearing girder weighing 10 tons has been let in, and on this girder the east end of the span rests. The west end rests on a pier provided with rollers and rockers.

The normal tunnel has a span of 26 feet 2 inches springing to springing, and 25 feet 6 inches between side walls with a splayed plinth course; the arch is semi-circular. The tunnel for the station ground is 52 feet span, the arch being segmental, having $\frac{1}{4}$ span rise.

The tunnel is under house property the entire length, and it was therefore not always possible to sink shafts where they were desired. Five shafts 10 feet square were sunk, from the bottom of which headings 11 feet and 12 feet were driven in each direction, and the greatest error in line and level was under $\frac{3}{4}$ of an inch.

The tunnel portion—about 800 yards—is almost entirely through red sandstone rock, which, like all the rock in the neighbourhood of Liverpool, is of a very treacherous character, heavy backs and wet clay beds being frequently met with, necessitating heavy timbering, a large number of the crown bars having to be built in; the tunnel has therefore had to be lined throughout its entire length; all the lining is faced with brindle bricks built in cement.

At about 170 feet from the entrance the tunnel crosses at an angle of 28°—27′—40″ over the tunnel of Cheshire Lines Committee Railway, through which the trains of the M.S. and L., G.N. and Midland Railways run, and the greatest distance that could be allowed between the overhead rails and the crown of the Cheshire Lines tunnel 2 feet 9 inches.

From a Photograph] [*By Brown, Barnes & Bell.*

Tunnelling Operations on the Overhead Railway.

After careful consideration, the engineers decided that the only safe way to effectually make the crossing was by turning a segmental screen arch, five rings thick, built with brindle bricks in cement, over the Cheshire Lines arch, and to build side walls of the overhead tunnel on this screen arch. This was carried out as follows:—A top heading 120 feet in length was driven along the crown of the Cheshire Lines tunnel, and then 8 feet lengths were excavated, baring the Cheshire Lines arch for that length. The exposed arch was then haunched with concrete, and the screen arch turned on sand, with $\frac{1}{2}$-inch narrow boards placed on it, and when the arch was set, the sand and boards were withdrawn, leaving a clear space of 6 inches over the Cheshire Lines arch, so that no additional weight could come on the Cheshire Lines tunnel arch. During these operations all the rock above had to be carried on timber.

To guard against possible fall of rock which might crush

the Cheshire Lines arch, before commencing the above operations, a shield was put inside the Cheshire Lines tunnel. This shield was made of 8 inches × 5 inches H steel joists at 4 feet 3 inches centres, bent to the radius of the tunnel, and carrying 4-inch laggings, and keyed up tight by means of folding wedges to the soffit of the arch.

The Overhead Railway Company had also to provide for the Cheshire Lines at some future time, having to construct another tunnel on the east side of their existing tunnel; and, to avoid any interference with the traffic during the future, it was decided to build a length of tunnel arch seven rings thick, on which arch the Overhead Railway side walls are carried. All the excavation for this crossing has been done entirely by hand labour, and has proved a most expensive and anxious piece of work. The illustrations show the tunnelling in progress.

From a Photograph] [*By Brown, Barnes & Bell.*

Tunnelling Operations on the Overhead Railway.

Further on the tunnel passes under a 5 feet × 3 feet sewer, and to avoid disturbing this, the arch was altered from semi-circular to segmental, which just permitted with care, the sewer to be underpinned.

The trains on entering the tunnel are automatically lit up from copper conductors suspended from the roof of tunnel, collectors being fixed on the roofs of the carriages. These lights are fed off accumulators, so that if a train should be stopped in the tunnel due to short circuit on the line, the carriages will not be in darkness.

The terminal station of this extension is situated at Park Road, otherwise called the Dingle, below the road level. The underground station consists of an island platform about 27 feet, with suitable sidings for accommodation of the trains. The station is ventilated by a large upcast shaft. The access to the station is by means of a subway at a gradient of 1 in 14.

The station is lit throughout by electricity, the underground portion by arc lamps at 110 volts, supplied by a transformer off the main current. Battery lights are provided in the event of a short circuit on the line.

The permanent way and main conductor are of the same section as on the present railway, but the rails are laid on the usual cross sleepers with cast-iron chairs to distribute the pressure.

As more generating plant was necessary to work the additional number of trains, it was decided to increase the size of the original generating station, and to run feeding cables a length of about two miles so as to regulate the E.M.F. instead of building another generating station, as it was found that this method would cheapen the working costs. The addition to the generating station consists of two engines built by Messrs. Hick & Hargreaves, and two new dynamos and switchboard, built by Messrs. T. Parker & Co., of Wolverhampton.

The two new engines are Corliss valve engines, each of the horizontal surface condensing type, having cylinders 15½ inches, 31 inches by 3 feet stroke, each intended to give 400 I.H.P. as an economical load, when running at 100 revolutions per minute, with a boiler pressure of 120 lbs. per square inch. The engines are of ample proportions throughout, and are fitted with a steam jacketed receiver between the cylinders containing boiler pressure steam. The beds are of the box type, and of heavy section. The fly-wheels are 14 feet diameter, and are grooved for 19 ropes, each 1¼ inch diameter. The condensing apparatus is a separate plant, having its own air and circulating pumps.

Among other features of the new engines are, first of all, the construction of the cylinders, which are of the four-valve Corliss type, which, instead of being cast in one piece, as is usual, are each built up of four principal castings, namely, a working barrel, a jacket, and two end pieces containing the circular steam and exhaust valve chambers, thus

substituting four comparatively simple castings, which can each be cast of the mixture most suited to its purpose for a single casting of so complicated a character, that it can only be cast of a comparatively soft mixture, and it is even then liable to failure from initial stress, aided by unequal expansion. This subdivision not only reduces the chance of disablement, but should such occur, the defective part may be replaced with much less expense and delay than a complete cylinder. Both cylinders are thoroughly steam jacketed, the steam traversing the jackets on its way to the respective cylinders. The governors are rope driven, and are of a new design, especially intended to combine the powerful governor with one of great sensitiveness, for dealing with great variations of load.

The output of each dynamo is 500 volts, 500 amperes, at a speed of 420 revolutions per minute.

The armatures are so arranged as to be interchangeable, identical in the matter of external dimensions with the existing ones, the resistance from brush to brush measures ·010 ohms. The magnets, however, instead of being of the double horse-shoe type, as in the original machines, are of a single horse-shoe, with the poles at the top. This has resulted in an increase of efficiency, the shunt resistance being now 100 ohms as against 75, making an *electrical efficiency* of 98 per cent. The loss in hysteresis, eddy currents, windage, &c., amounts to 6,000 watts, so that the *commercial efficiency* at full load will be about 95·7 per cent.

The magnets are of special magnetic steel of the highest permeability, and are arranged with the patent hinged pole pieces. This allows of ready access to the armature for inspection, cleaning, or lifting, without the necessity of unsetting the bearings.

The dynamos are rope-driven by 19 1¼-inch ropes, the rope pulley running between two bearings, and the pulley shaft being connected to the armature by a coupling, so that the armature can be changed without disturbing the ropes. The bearing at the commutator end of the machine is of the spherical type. The diameter of the shaft through the bearings is 5 inches, the length of each bearing being 1 foot 5 inches.

The brushes are of phosphor bronze lined with white metal, the top brasses of each bearing being slotted to receive *two* lubricating rings, the bottom brass being continuous.

The total weight of the machine is 24½ tons, the armature being 3 tons 2 cwts.; the steel magnet casting alone, without winding, is 12 tons.

The main switchboard consists of six slate panels, with sets of switches and instruments, one set for each dynamo in generating station.

Each panel is fitted with—

One patent double pole automatic magnetic cut-out, with plate glass shields to protect the attendant from the arc, in case a short circuit on the line causes the cut-out to open with excessive load. These cut-outs are also employed as main dynamo switches, being made and broken by hand for connecting the individual dynamos to the omnibus bars. The magnets of the cut-out are compound wound, so that the circuit is broken immediately in case of a reversal of current.

One single pole throw-over switch for connecting the dynamo circuit (beyond the automatic cut-out) either to the omnibus bar, which feeds into the central conductor at the nearest point to the generating station, or through a feeder to a distant point on the line to equalise the E.M.F.

One 33-way sliding, regulating switch to vary the resistance in the dynamo shunt circuit for maintaining the E.M.F. of each dynamo constant.

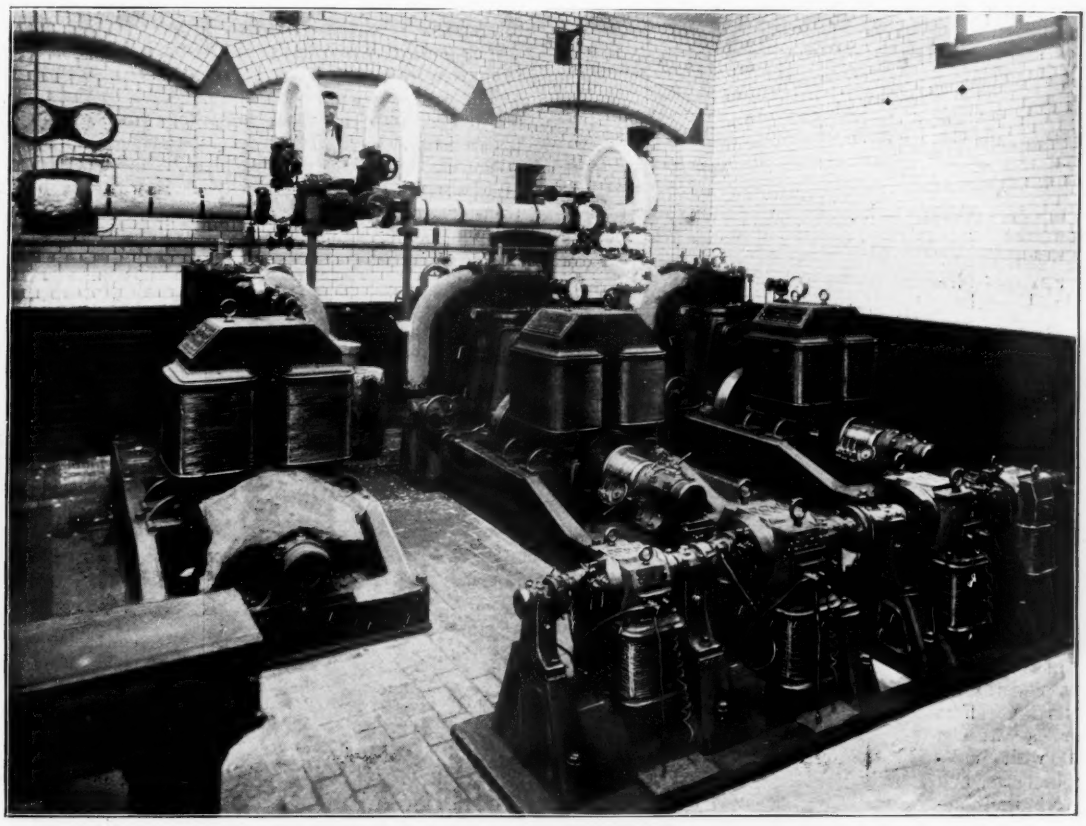
One set of double pole plugs for connecting voltmeter to dynamo before paralleling.

One "Weston" ammeter, indicating the current passing from each dynamo to the line.

The slate slabs are held on wrought-iron framework, all connections at the back being of heavy cast bronze rods, supported on pillars, so that all straps and connections are accessible, no insulated cable being employed.

The front of the board is finished off with massive teak carved pillars and panels.

Besides the instruments already described, there are four



The Chester Dynamo Room with Motor Alternators in Foreground.

"Weston" voltmeters, with illuminated dials, and an engine room clock supported on panelled framework above the slate slabs. The voltmeters are arranged as follows:—

One connected directly across the omnibus bars.

One for connecting at will to any dynamo by means of plugs to take E.M.F. before paralleling.

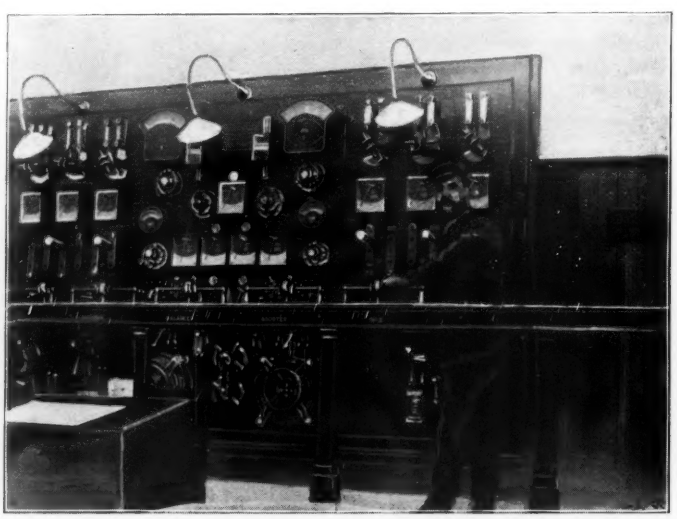
One for connecting across brushes of the dynamo running on the feeder circuit.

One as pilot voltmeter connected to the distant point in the line where feeder is coupled.

New rolling stock has been built by Messrs. Brown, Marshall & Co., and as the number of passengers carried is now over 7½ millions a year, the directors have found it necessary to increase the size of the trains by composing them of three carriages instead of two. In fact, last half-year (excluding Bank holidays), an average of 60 per cent. of the seating accommodation of the trains was occupied. The new motors built by the Electric Construction Company are very similar to those at present in use, their strength being increased to meet the additional weight of trains. The following table gives particulars:—

Weight of armature ex. wheels, lbs.	Weight magnets and attachments.	Draw bar pull.		Speed with 50 amps.	Max. Efficiency.
		With 120 amps.	With 60 amps.		
2,184	6,066	2,030	680	26 M.P.H.	86 %

As this new rolling stock will only be a small portion of that owned by the company, it will be necessary to increase the number of carriages in the original trains, but as the first motors were only designed for two carriages, experiments have been made with a train fitted with a new and very ingenious form of roller bearings designed by the Roller Bearing Company. It has been shown by the falling weight test that this train will start at a great reduction in starting effort over a train fitted with ordinary bearings, and therefore the company will be able, by slightly modifying their present motors and adopting roller bearings, to increase the carrying capacity of all their trains by adding an additional carriage. The engineers for the Southern Extension have been Sir Douglas Fox, M.Inst.C.E., and the late J. H. Greathead, M.Inst.C.E., and Mr. Cottrell has acted as resident engineer, assisted by Mr. Norman and Mr. Fright, and the contractors have been Messrs. Pearson & Knowles for the viaduct portion, and Messrs. H. M. Nowell and C. Braddock for the tunnel portion.



Chester Switchboard.

THE ELECTRIC LIGHTING OF CHESTER.

The chief points of interest in the Chester Corporation electric lighting system arise from the employment of a three-wire system with 420 volts across the two outers, and the use of 210 volts in the houses. It clearly shows the unmistakable extension of area which is permitted to the low pressure system by the use of 200 volts in the houses, and that the objections from the consumer's point of view are immaterial compared with those that might arise in a system which is changed over from 110 to 220 volts.

The distance of the extreme feeding point from the generating station is 1,622 yards, and the greatest distance of a consumer's terminals from the generating plant is 1,900 yards, but we believe it is the intention to go considerably beyond these points, and there seems to be no reason against a further extension. In the use of 200 volts in the houses no trouble of a serious nature seems to have been experienced, nor has it been necessary to materially alter the methods of wiring that are usual with the lower pressure. Here and there some slight modification of wiring rules has been necessary, but they are scarcely worth speaking of. Minor troubles have arisen in fuses in ceiling roses, and key sockets are rather inclined to be troublesome, but altogether Mr. Thursfield, the engineer in charge of the works, considers the ordinary wiring and fixtures generally reliable for the increased voltage. Consumers purchase their lamps in the open market, but we do not think they experience any difficulty in securing lamps that are satisfactory in their performances.

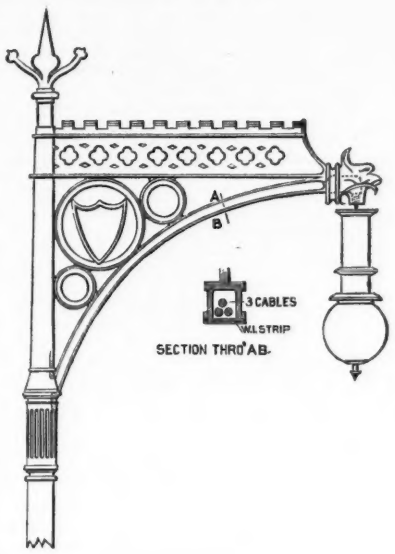
The present system in use at Chester is based on a scheme submitted by Messrs. Thos. Parker, Limited.

The works are situate on the outskirts of the town, and are divided into the usual rooms for dynamos and engines, boilers and battery. The most interesting room is the one where the electrical generating plant is erected, and a view of this shows the three main dynamos, with the balancing transformer in the foreground.

Commencing with the steam raising plant, the boilers consist of three Babcock-Wilcox boilers, the working pressure of which is 160 lbs., each evaporating 5,000 lbs. of water. The valves and boiler fittings in general have been supplied by Messrs. Turnbull, of Glasgow. An interesting feature in connection with the steam raising plant is the Green's economiser, consisting of 144 tubes, the scrapers of which are driven by an electric motor. The economiser is intended to raise 1,000 gallons of water per hour from 60° to 200° F. There is a feed water tank which is kept supplied with water from the town mains; it is also connected with the discharge pipe from the condenser. Tangye's duplex pumps are used, each of which can deliver 1,500 gallons of water per hour to the boilers. The feed pipe service is in duplicate throughout. The steam pipes are arranged on the ring main principle, and the valves are arranged to provide for the cutting off of any one engine or boiler. Lap-welded steam pipes are used for the main ring, the smaller pipes being of solid drawn copper with wrought-iron steel flanges. The boilers and pipes are covered with non-conducting composition made by the Washington Company, all the flanges and valve boxes on the steam range being covered with the same composition. A Körting ejector condenser, capable of condensing 10,000 lbs. of steam per hour. This is supplied with water from the canal by means of a motor driving a centrifugal pump, which is capable of discharging 700 gallons of water per minute to a height of 20 feet above suction pipes.

The engine room plant consists of three Belliss two-crank compound engines, combined with Parker dynamos. The

engines indicate 135 H.P. when running at a speed of 380 revolutions per minute, with a steam pressure of 150 lbs. per square inch. Forced lubrication is employed. The engine will run either condensing or non-condensing, and all working parts are lubricated by pump.



The dynamos, which are shunt wound, are mounted upon an extension of engine bed-plate and coupled direct to crank-shafts, each giving 440 volts, 184 amperes, at 380 revolutions. They are of the two-pole type, furnished with drum armatures wound with Eickmeyer coils; magnets of cast-steel, pole-pieces cut through on horizontal diameter, the lower portions being mounted in brass cradle fitted into engine bed-plate; the upper portion of horse-shoe magnet in one piece, and lifts off together with the magnet winding so as to give access to the armature and allow of this being taken out by a direct vertical lift.

For balancing the system two machines coupled together act as dynamo-motor. Each of these machines is arranged to carry a current of 50 amperes at 220 volts, so that it is capable of dealing with 100 amperes passing in the centre wire. Coupled up on to each end of this balancing transformer are two small dynamos, having their fields separately excited across the centre wire of positive and negative bus bars respectively.

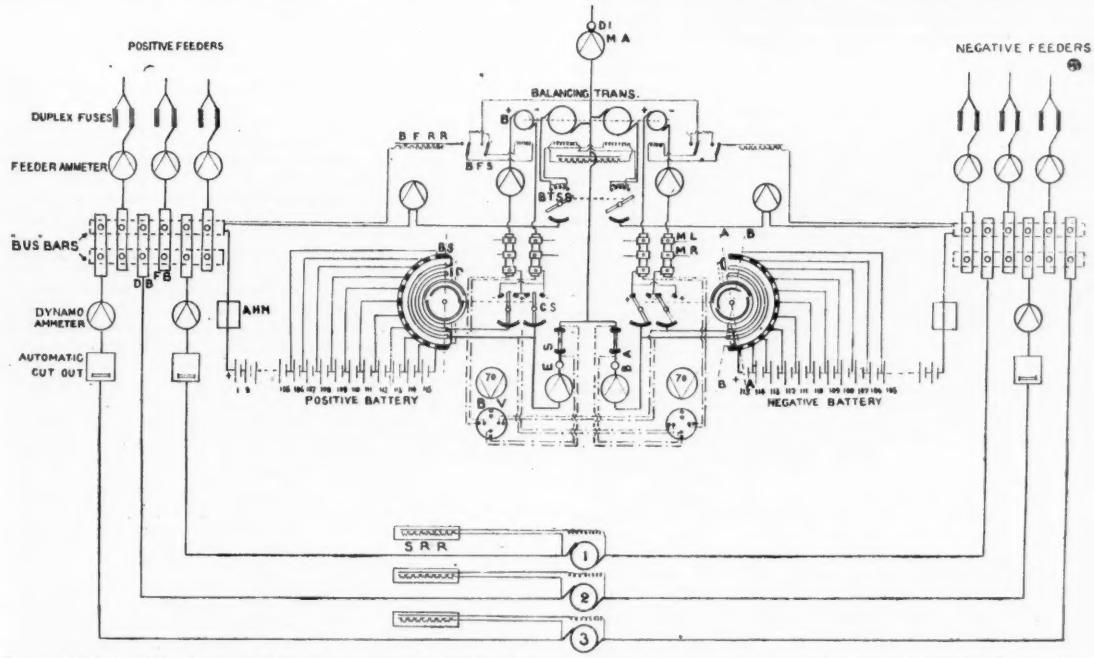
Each of these machines is capable of giving a current of 50 amperes at any E.M.F. from 10 to 70 volts, the variation being obtained by a resistance in the field circuit. The power for driving these small dynamos is supplied by the balancing transformer. The small dynamo armatures are connected one on each side of the centre wire in series with the regular station pressure, so as to give the excess volts required for battery charging.

In conjunction with the generating plant are two sets of accumulators. The cells are of the E.P.S. K-type, which have a normal capacity of 300 ampere-hours, and are designed to give also 60 amperes for five hours, 80 amperes for three hours, and 120 amperes for half hour. The main function of the battery is to act as regulator, and to furnish current for the day load. Each battery is provided with a set of milking cells, which can be switched in or out at the switchboard. The switchboard, which is shown in one of the illustrations, and the connections of which are given in the diagrammatic sketch, consists of three panels of enamelled slate carried on an iron frame. The board is provided with Kelvin-Ampere gauges, and electrostatic voltmeters; also Weston illuminated dial voltmeters for feeders, together with plug bars, cut-outs and switches for dynamos, switches and duplex fuses for three positive and three negative feeders, battery regulating switches, &c. Each dynamo circuit is provided with a Ferranti ampere-hour meter; hot wire recording voltmeters across each side of the three-wire system.

All the feeders and distributing mains are lead covered and armoured cable, made by Callender's Cable Company; the feeders being concentric with a single cable for the third wire, and the distributing mains being triple concentric. Pilot wires are employed from each sub-feeding point. The main feeders are run to one central point, from which five branch "sub-feeders" are run, joining to the distribution mains at five sub-feeding points.

Arc lamps have been erected for street lighting, 21 being on posts and seven on brackets, the lamps being made by Messrs. Johnson & Phillips.

The buildings were erected for Messrs. Parker & Co., Limited, by Mr. Thomas Browne, Chester, Messrs. J. H. Davies & Sons, of Chester, acting as architects.



Battery switch in position for putting booster in or out when charging battery. Battery switch shows position when booster is helping battery to discharge.
N.B.—Line, A, A, shows limiting position from which the brushes can rotate counter clockwise only 1½ revs. to line, B, B, the other limiting position.

D, I, Direction indicator; M, A, Middle wire ammeter; B, F, R, R, Booster field regulating resistance; B, F, S, Booster field switch; B, T, S, S, Balancing transformer starting switch; B, Booster; B, S, Battery switch; I, P, Interlocking plate; C, S, Change-over switch; M, L, Milking leads; M, R, Meter room; E, S, Emergency switch; B, A, Battery ammeter; B, V, Booster voltmeter; A, H, M, Ampere hour meter; D, B, Dynamo bar; F, B, Feeder bar; S, R, R, Shunt regulating resistance.

DIAGRAM OF SWITCHBOARD CONNECTIONS.

Messrs. Parker's contract included the entire installation, as well as the station buildings, and they run the station for the Corporation at a fixed rate for arc lighting, and fixed rates per unit for private lighting, depending upon the amount sold. Applications from consumers are already considerably greater than the capacity of the plant installed, and extensions to the generating plant are now in hand.

CONTRACTS OPEN AND CLOSED.

OPEN.

(*Continued from page* 138.)

Germany.—February 6th. The Cologne Direction of the Prussian State Railways is inviting tenders for the supply of 171½ tons of galvanised telegraph wire, 6 tons of bronze wire, 3 tons of insulated wire, and 44,100 porcelain insulators. Tenders to the Königliche Eisenbahn Direction, Domhof, 28 (Zimmer 27), Cologne.

Hull.—February 1st. The Corporation of Hull is prepared to receive tenders for a lease of the tramways authorised to be constructed by the Tramways Orders Confirmation (No. 1) Act, 1896.

Jamaica.—April 15th. The Privy Council invites applications for a license for the establishment and working of a system of rapid transit in Kingston and environs. Copies of the Tramways Law, 1895, and of local rules and maps of Kingston and environs may be seen at the offices of the Crown Agents for the Colonies, London.

Wallasey.—February 18th. The District Council invites tenders for the supply and erection of a 200 kw. alternator with engine combined and for the requisite switchboard extensions. Particulars on application to the engineer, Mr. J. H. Crowther, the Great Float, near Birkenhead.

CLOSED.

Belfast.—The Electric Light Committee have accepted the tender of Messrs. Gill & Russell for a supply of iron pipes for the year.

Glasgow.—The Electric Lighting Committee have placed an order with the India-Rubber, Gutta-Percha and Telegraph Works Company, for 2¼ miles of india-rubber cable.

Southampton.—Eleven tenders were submitted for the additional electric cranes and alterations required by the Harbour Board and the lowest—that of Messrs. Stothert & Pitt at £7,228—has been accepted. In moving the acceptance of the tender, Mr. Alderman Bone said perhaps some members of the Board might think they were not quite justified in recommending the acceptance of a tender for £7,228, though they had only one lower which complied in every respect with the specification, whilst the highest tender for three three-ton cranes, one twelve-ton crane, and alterations, the same as were included in the tender of Messrs. Stothert and Pitt, was £11,497, by Messrs. Clarke, Chapman and Co., Limited. There were four tenders lower than that of Messrs. Stothert & Pitt, but only one of the firms tendering, as he had stated, complied with the specifications, and that was the Bedford Engineering Company, which only tendered for the three-ton cranes, their figure being £3,070 as compared with £4,597, while Messrs. Figee Bros., of Haarlem, tendered for the three-ton cranes at £4,250. Mr. Miller and himself (Alderman Bone) went to Bedford, and eventually they came to the conclusion that it would be the best policy to accept the combined tender of Messrs. Stothert & Pitt, at £7,228. They had had experience of these engineers, and had never had the slightest difficulty with regard to their present cranes since they were put up, added to which Messrs. Siemens & Co. had been selected for the electrical part of the work. They had therefore the greatest confidence in recommending the acceptance of Messrs. Stothert & Pitt's tender. Alderman Button said there was an enormous difference between the electrical engineer's protecting tender and the tender recommended for acceptance—£4,736 as against £7,228.

London.—We have received the following comparative note of tenders which were submitted a few days ago for the electric wiring and fitting of three London buildings. How can it be possible that the whole of the three buildings can be efficiently and profitably wired and fitted for £84, when two well known firms want about that sum for fitting one building only, *i.e.*, 30, Portland Place?

Name.	30, Portland Place.	Hereford House, Park Street.	32, Princes Gardens.	Totals.
Fred. A. Donnison, Berlyn, Evans & Co.	£84 0 0	£70 10 0	£54 6 0	£208 16 0
Rashleigh Phipps & Co.	80 0 0	66 0 0	60 0 0	206 0 0
Digby	49 6 6	34 0 0	38 17 0	123 3 6
Eastlakes, Ltd.. ..	35 0 0	28 10 0	21 9 0	84 19 0

MUNICIPAL INSURANCE.*

By COUNCILLOR G. PEARSON.

WHEN I was first requested to write this paper I entertained considerable doubt as to whether it would not be desirable to confine the discussion to the subject of the insurance of municipal power stations only, and not to discuss the general question of the insurances of the general properties belonging to municipalities, but on consideration I think it will be best to discuss the whole question rather than to confine my remarks to power stations alone.

No one doubts but that the business of an ordinary well-managed insurance company is exceedingly profitable, but if proof is wanted it will be found in the figures given in the table below, which show the value of the shares in a few good insurance offices:—

Company.	Amount originally paid per share.	Price per share.	Dividend paid per share.
	£ s.	£ s.	
Atlas	6 0	21 10	17 per cent.
Caledonian	5 0	30 0	23½ „
Commercial Union	5 0	32 0	25 „
Liverpool and London and Globe	2 0	46 10	75 „
London Assurance Corporation ...	12 10	51 0	20 „
London and Lancashire	2 10	16 10	20 „
Manchester	2 0	8 10	12½ „
North British and Mercantile ...	6 5	36 0	16 „
Northern	10 0	63 0	22½ „
Norwich Union	12 0	95 15	37½ „
Royal	3 0	47 0	57½ „

From these figures it will be seen that the premiums paid cover all risks, and leave a considerable margin of profit for the investors in this class of shares.

It may assist the discussion if I explain the position of the city with which I am best acquainted, viz., Bristol, in the hope that others may thereby be induced to give us the benefit of their knowledge of the position of other towns, as by these means accurate information may be obtained as to the position of many towns throughout the country, and we shall be thereby freed from the risk of generalising on too narrow a basis.

Bristol, like many other towns, received a notice from the company with which its power station was insured of a great increase in the rate of premium, viz., from 5s. to 10s. 6d.

A sub-committee was appointed to consider the question and to report.

The committee met and received information as to the insurance of the various civic properties, from which it appeared that the Docks property was insured for £339,535, at a premium of £1,085. These risks were taken by the company, subject to the fire offices tariff. The property is insured through the Hand-in-Hand Office, and has the advantage of that company's bonus return system on the portion retained by them, which provides that in cases where no claims are made the premium is returned once in every five years, a reduction of about 20 per cent.

The properties in the hands of the sanitary department are insured for £33,199, in the Yorkshire Office, at a premium of £36 5s., equal to 2s. 2d. per cent. In this policy there is the average clause, which protects the office against under insurance by the corporation. There are other smaller policies at special rates, such as hospitals, port hospital ship, steam launch, road roller, boilers, &c., making a total insurance of £58,199, at a premium of £152 13s. 7d.

The city properties in the hands of the finance committee are insured for £318,264, at a premium of £265 10s. 8d.

The electric light station and plant are insured for £14,000, at a premium of £74 0s. 6d., less £15 per cent. commission.

The aggregate amount of the municipal insurances in Bristol is £730,098, and the premiums amount to £1,577 4s. 9d.

From these figures it will be seen how various are the properties owned and insured by the Council of the City of Bristol, and how various are the natures of the risks.

After considering the foregoing and other information the sub-committee reported to the electrical committee, recommending the committee to re-insure for the year at the increased premium, and asking instructions as to any further consideration of the matter. The sub-committee were requested to further consider the question and to report. After having further considered the question the sub-committee recommended the committee to approach the Fire Insurance Tariff Committee in May or June, 1897, when they would have had further experience in corporation central station risks, and the committee would have plenty of time before their policy expired to make other arrangements in the event of no satisfactory terms being made by the insurance company.

We shall doubtless at no distant date reconsider the question, and I trust the discussion of to-day will assist the future deliberations of the Bristol Electrical Committee. I will now proceed to consider some of the suggestions from time to time made for solving the problem of municipal insurance.

First.—Shall we abandon insurance altogether? This in Bristol is a subject of considerable magnitude, and, being in the hands of four committees, unanimity would be difficult to obtain, and in the

* Paper read by Councillor G. Pearson, of Bristol, before the Municipal Electrical Association, on January 28th, 1897, at the Westminster Palace Hotel, London, S.W.

absence of any nucleus of an insurance fund would be one of grave risk. Indeed, so grave a risk that I can scarcely believe the Docks Committee would feel justified in running it. Personally, I believe it would in the end pay, but the risks would fall on the ratepayer of to-day, who would first have to take the risk of an absolute loss by a big fire, and in addition would have to contribute a payment to a fund to provide the ratepayer of the future against the risk he of to-day is taking.

I think these reasons would weigh very heavily on the Council in the event of any discussion taking place having for its object the proposal for a general abandonment of insurance by various insurance offices, and the suggestion that the Council should assume that responsibility itself.

Secondly.—Shall we insure partially? A suggestion has been made by a gentleman having considerable experience in the insurance against marine risks that the Council should begin by becoming its own insurers for one-half of the value of its properties. This suggestion appears to meet some of the difficulties of the former suggestion. The ratepayer of to-day would not assume such serious responsibilities, and the half premium saved from the insurance company would in course of time form the nucleus of an insurance fund, which may ultimately induce the ratepayer of the future to assume the whole responsibility of a total abandonment of insurance by means of insurance companies.

The large profits made by all well managed insurance companies, as appears from the foregoing figures, would seem to show that the average premiums more than cover average risks, and the action of the Tariff Committee in the matter of the insurance of electric light stations would appear to show that in the absence of any alternative proposals there is very little chance of any material reduction in the charges now made by them, and which their complete system of combination enables them to extort from the insuring public.

Thirdly.—Shall the electrical committees of all municipalities abandon the insurance of their stations?

To this question, so long as the present rate of premium exists, I have no hesitation in answering, yes. The premiums extorted by the tariff committee by means of the combination to which I have before alluded are in excess of what is required to cover the risks, and have in my opinion been increased not on account of fires at electric light stations, but on account of fires at electric appliance manufactories. But the first question that arises is not who shall "bell the cat"—we are all ready to do that—but "How shall we bell the cat?" The difficulty I have before pointed out as to starting an insurance fund exists here, but to a smaller extent. The risk is not very large, but there may be difficulties in inducing a town council to face it, small though it is, especially when the natural fears of a councillor are increased by the active canvass of interested insurance agents. But I see one way out of the difficulty. There are few towns which are not by this time either making a profit or fast approaching that much desired time when they will, and I would suggest, as a means of cutting the knot which we find it impossible to untie, that electrical committees should ask their councils to allow them to use the first profits made to forming an insurance fund, say in Bristol of £4,000 or £5,000, other towns forming such funds as they think the size of their stations demand. The interest on this fund, plus a very small annual payment, would in a few years place each electrical committee absolutely out of the reach of fire risks without the intervention of a profit-earning company, and without any appreciable call on the ratepayers. This would remove the one great difficulty in starting an insurance fund, viz., the necessity of appealing to the rates to raise it in the first instance. Personally, I should scarcely feel justified in allowing a municipal electric lighting undertaking with which I was connected to remain uninsured without any fund in hand to meet a possible loss, without making a serious call on the rates for the half-year in which the fire occurred.

Suggestions have been made for a mutual insurance fund to be formed by municipalities for general insurance. This has at first sight much to recommend it. The municipal risks are, as a rule, good. The credit of the parties concerned is unquestionable, and these characteristics would appear to promise an ultimate success. But on further consideration difficulties suggest themselves.

First.—Have corporations the necessary power to join together and mutually guarantee each others risks. Personally, I cannot say that I think they have. But this difficulty can be removed by legislation, supposing a case to be made out for the change. But assuming this to be done, and power to be obtained, on closer consideration are the risks so simple and so uniform in character as they at first sight appear? Let us examine my own town, Bristol. We do the whole of our scavenging by means of men in our employ, and by means of our own horses and plant. We should therefore require stabling for 200 horses, with the necessary plant, carts, harness, and also the accompanying workshops for the production of carts and harness, to be covered, and in addition we have a dock undertaking to be covered to the extent of between £300,000 to £400,000, with risks greatly varying in degree, to say nothing of the electric light undertaking itself. It appears to me to be too much to hope that an ordinary town council, employing contractors for its scavenging, having no trading undertaking such as our Bristol Docks; in fact, having only municipal buildings, and possibly municipal estates to cover, would be prepared to join a town situated as Bristol is at this moment, and make a mutual insurance of such very varying risks. If this is so, then we are driven to differentiate our respective risks, and charge increased premium for one risk as against another in different towns. Then we get to the position of an ordinary insurance company with varying premium, and should, I am afraid, ultimately find ourselves quarrelling as to rates precisely as we are now, the only difference being that now we quarrel with the insurance companies, and then we shall be quarrelling amongst ourselves. A further suggestion has been made for the formation of a mutual fund for the insurance of municipal electric lighting stations alone, but the same difficulties present themselves in a slightly modified form. The electric risks of various towns may not vary to the extent I have pointed out in the case of general risks, but I think few will deny that the risks would vary very much, and in seeking to correct these variations, we should find ourselves driven back again to a varying premium, with the endless possibilities for disputes as to amounts. In the face of these difficulties I cannot see any reasonable hope of forming a mutual fund for general municipal insurances, or even for the insurance of electric lighting stations alone, and I must wait the evolution of a workable scheme by some man of greater experience than myself.

Having looked at this question from various points of view, I am driven to the conclusion that the best arrangement is for each town to seek to become its own insurer.

First.—As to the general risk.

By becoming, in the first instance, its own insurer in part only, accumulating the premium saved to form the nucleus of an insurance fund, and setting aside, half-yearly, a small additional sum from the rates to aid in the formation of the insurance fund, and by these means a fund may be raised in a few years of sufficient size to justify the abandonment of ordinary insurance altogether; the period of total abandonment depending greatly on the freedom from fire losses in respect of the corporation properties.

Second.—As to its electrical risk.

In this case the difficulties are not so great, as I have said before there are few installations in existence which are not fairly well built, and where profit is not already being made, or will be made at no very distant date. Nothing would be easier, in my opinion, than to obtain leave from the council to set aside a fund equal to the profits of the electric light installation for a few years to form an insurance fund; and even if the council declined to set aside a sum equal to the whole profits, they may be induced, at any rate, to set aside a portion of the profits; in which case the day when ordinary insurances could be abandoned would only be delayed a short time longer, and failing the adoption of either of these courses, the only other alternative I see is to assist in the formation of several non-tariff offices. One would be of no use, as it would be boycotted by the tariff offices; and, therefore, incapable of re-insuring. This last suggestion I look upon as a last resort in the event of the previous suggestions failing to meet with the approval of town councils generally, and not to be seriously entertained until the other proposals have either failed to obtain a trial, or have failed after having obtained it.

There was a fair gathering of members of the Municipal Electrical Association yesterday at the Westminster Palace Hotel on the occasion of the reading of the foregoing paper. Mr. C. H. Wordingham, the President of the Municipal Electrical Association, presided over the proceedings, and pointed out that the fire offices had seen fit, some time ago, to raise the premiums on electric light stations. The Association called a meeting, and the result was, that Mr. Councillor Pearson was asked to read a paper on the subject. As an Association, they were not in a position to take any action in the matter. What they had to do was to lay down the general feeling of borough electrical engineers throughout the country on the subject, and their united opinion would form a guide for each corporation in dealing with the matter.

The discussion which followed the reading of the paper was a very lengthy one, and ultimately the meeting adopted the following resolutions:—

1. In the opinion of this Association, the action of the insurance offices in raising the rates of premiums for insurance of electrical generating stations is quite unjustifiable, and in their opinion some joint action of municipalities is called for in consequence.

2. That in the opinion of this Association the most feasible method of providing against risk from fire in electrical generating stations is for each municipality to set aside each year from the gross profits a certain sum to form a fund for the purpose of meeting such risks, and where the profits do not admit of such sum being set aside, it is desirable to insure in those offices that are willing to investigate each risk on its merits.

3. That it is desirable for a Committee of this Association to ascertain the capital involved in generating stations, the premiums paid, and the basis of assessment of the insurance companies, and to report the result of their investigations at the next annual Convention.

NOTES.

Aluminium.—The advance which is being made by the British Aluminium Company, Limited, in the production of aluminium at the Falls of Foyers, was recently referred to in these columns. The company is now the largest producer of this metal in the world, its regular effective horse-power employed nearly doubling that used by the Pittsburgh Reduction Company, of Niagara, *i.e.*, the British company regularly employs 2,500 H.P., out of an intended 25,000 H.P., and the Pittsburgh Company only uses 1,450 H.P. According to *Industries and Iron*, the company has no foreign competition to fear in the English market, and the Pittsburgh Company is greatly handicapped by having to buy its raw material in France, have it treated in Germany, and then shipped to America.

The Board of Trade's Approval of Electric Meters.—The Board of Trade have approved of the Chamberlain and Hookham and the Ferranti meters in the following terms:—

(H. 9,247.)

Board of Trade, Whitehall Gardens,
London, *October* 28th, 1896.

For the purposes of the Electric Lighting Acts, 1882 to 1890, and all provisional orders and licenses made and issued thereunder, the Board of Trade approve of the pattern and construction of the meter for the measurement of electrical quantity, when supplied on the constant potential continuous current system, hereinafter described, viz.:—The meter deposited at the Board of Trade by Chamberlain and Hookham, Limited, of 4, New Bartholomew Street, Birmingham, and sealed by the Board of Trade, and known as the Hookham meter.

The Board of Trade further approve of the following manner of fixing meters of this description, and of connecting them with the service lines:—

The meter is to be fixed by screws to a horizontal support.

In connecting the meter with the service lines one service line is to be cut and the ends bared of insulation at the cut for about 1 inch, the insulation being cut straight across. The outside of the insulating material is to be made to fit closely the hole through which the line is passed to the terminal, India-rubber tape or other insulating material being wound on to the requisite thickness if necessary.

The connection is to be made so that the current is passed through the meter in the right direction, viz.:—from the terminal marked + to the terminal marked —; the conductors are to be tightly clamped in the terminals; the insulation between each conductor and the case is to be good; and the ends of the conductors are not to project beyond the tops of the terminal boxes.

Signed by order of the Board of Trade this 27th day of October, 1896.

T. H. W. Pelham,
Assistant Secretary, Board of Trade.

(H. 9,248.)

Board of Trade, Whitehall Gardens,
London, *October* 28*th*, 1896.

For the purposes of the Electric Lighting Acts, 1882 to 1890, and all provisional orders and licenses made and issued thereunder, the Board of Trade approve of the pattern and construction of the meter hereinafter described, for the measurement of electrical quantity when supplied on the constant potential continuous current system, and where the arrangements are such that no current exceeding the proper maximum current for which the meter is intended by more than 50 per cent. can be passed through it, viz., the meter deposited at the Board of Trade by S. Z. de Ferranti, Limited, of Charterhouse Square, London, E.C., and sealed by the Board of Trade, and known as the Ferranti meter.

The Board of Trade further approve of the following manner of fixing meters of this description, and of connecting them with the service lines:—

The meter is to be fixed on a horizontal support and to be screwed to such support, or to the vertical wall to which the support is attached.

In connecting the meter with the service lines, one service line is to be cut and the ends bared of insulation at the cut for about 1 inch, the insulation being cut straight across. The outside of the insulating material is to be made to fit closely the hole through which the line is passed to the terminal, India-rubber tape or other insulating material being wound on to the requisite thickness if necessary.

The connection is to be made so that the current is passed through the meter in the right direction, viz.:—from the terminal marked +, to the terminal marked —; the conductors are to be tightly clamped in the terminals; the insulation between each conductor and the case is to be good; and the ends of the conductors are to be well separated inside the meter.

Signed by order of the Board of Trade this 27th day of October, 1896.

T. H. W. Pelham,
Assistant Secretary, Board of Trade.

Islington v. Lambeth.—An Islington newspaper, priding itself upon the possession of municipal electric lighting works, now that a profit has been shown on the undertaking, tries to impress its readers with the great value thereof by the following statement:—

Mr. Lambert has vested in the ratepayers a most valuable property. Its real worth may be best understood by what has happened in Lambeth, where the Vestry, refusing to take up the privilege, a sharp speculator applied for the order, and promptly sold it to a company for £325,000.

This is a ridiculous error. Mr. Sax sold the powers to a company *with a registered capital* £325,000.

Partnership.—Mr. Eliot C. Pringle, A.M.I.E.E., late of Faraday House, and of the Kingston Corporation Electric Light Station, has recently joined the firm of Harrison, Coles & Co., electrical engineers, of Richmond and district. Messrs. Harrison, Coles & Co. have extended their Richmond works, put down larger plant, and opened new offices and showrooms at Kingston-on-Thames.

Anniversary Dinner of the Junior Engineers.—The twelfth anniversary dinner of the Institution of Junior Engineers was held at Westminster Town Hall last Saturday evening. Mr. Alexander Binnie, M.I.C.E., engineer to the County Council, the President of the Institution, occupied the chair, and among the best known guests and honorary members present were Sir G. Harris, Sir Henry Mance, Prof. Barr, and Commander Wells, R.N., chief of the Metropolitan Fire Brigade. The toasts were judiciously interspersed with musical items, Mr. T. E. Gatehouse, Mr. E. C. de Segundo, Mr. Ernest King, and others, rendering yeoman service in this direction. After the usual loyal and parliamentary toasts, Sir Henry Mance, in proposing "Greater Britain," spoke of the great development of India by means of the telegraph; it had softened down the prejudices of caste, and by its aid the lives and properties of our fellow subjects were protected from internal warfare. The telegraph cable had done as much for federation as all the legislation of the past 15 years. He hoped that the cable across the Pacific would be completed during Her Majesty's reign, and when taken in hand it would be completed by British enterprise, by British capital, and by British engineers. Sir G. Harris, in replying to the toast, spoke of the broadening influence of a colonial life. The toast of the evening, the "Junior Engineers," was given by Commander Wells, and replied to by Mr. H. Bloomfield Vorley; and the toast of the "President" was given by Mr. Edmonds A. Berry, and acknowledged by Mr. Binnie. Other musical items followed, and an enjoyable evening was brought to a close by the singing of "Auld Lang Syne."

Fatal Shock.—It is stated that a young man named Leslie Jamieson was killed last Saturday morning by receiving a shock from the electric power plant at Messrs. Hawthorn, Leslie & Co.'s engineering works at Newcastle.

Death from Electric Shock.—A gas contemporary says that at Charmanvilliers, near Besançon, some workmen were recently engaged in getting out an old and superseded electric cable which ran parallel to the new one. The new one was in action. One of the workmen shook the old cable in trying to get it out, until it touched the new one. He was killed on the spot, and another, who was helping him, was knocked senseless, and remained in that condition for a long time.

Personal.—Upon the reorganisation of the staff of the Epstein Electric Accumulator Company, Limited, Mr. L. Broekman and Mr. Percy W. Northey, A.I.E.E., have been appointed joint managers; Mr. Northey will also act in the capacity of secretary.

Electrical Standardising, Testing and Training Institution.—Over 200 people were present at the dinner of this Institution, held at the Imperial Institution on Wednesday evening. Among the distinguished guests were Sir Courtenay Boyle, K.C.B., Sir Henry Mance, Prof. Carey Foster, Prof. Vernon Boys, Mr. C. E. Spagnoletti, Mr. Henry Edmunds, Mr. James Swinburne, and many others. Lord Castletown of Upper Ossory, occupied the chair, and in proposing the loyal toasts, made special reference to the present year of Her Majesty's reign. Sir Henry Mance, in proposing the "Electrical Standardising Institution," spoke of the advantages in electrical science enjoyed by the present generation. Fifty years ago, the only electrical text-book was that of Mr. Culley ("good old Culley," interjected Sir Henry). He congratulated the Institution on the lines on which it was worked, and spoke of the important work that lay before the young engineers. Mr. Robert Hammond responded. Lord Castletown proposed the toast of "The Students," which was acknowledged by Mr. C. D. Taite and Mr. R. Dumaresq. "The Visitors" was given by Mr. Francis Ince and Sir Courtenay Boyle, in replying, said the electrical industry in 1896 showed a continuous and steady progress. He referred to the fact that two meters had at last come up to the Board of Trade standard. Applications for provisional orders had increased by some 50 per cent. Whether that was due to the increased prosperity of the country, or to increased electrical knowledge, it was one upon which they could congratulate themselves. Various other toasts were given before the proceedings terminated.

Dynamo Design.—The Institution of Junior Engineers has arranged for a course of six lectures on "Dynamo Design, Construction and Working," to commence next Tuesday, February 2nd, and continue on each alternate Tuesday until April 13th. Mr. F. A. Nixon, of the Westminster Electric Supply Corporation, and formerly with the Brush Electrical Engineering Company, has been engaged to prepare these lectures, with a special view to meeting the everyday requirements of those engaged in practical work in drawing office, workshop, and electric installation. The lectures will be delivered at the Westminster Palace Hotel at 8 o'clock p.m. The following is the syllabus:—

I. General principles, electro-magnetic and electric, underlying the action of a dynamo. Parts of machine. Electric, magnetic and mechanical actions and reactions in armature and field magnet. Eddy currents; hysteresis, &c. Objects to be attained in successful design.

II. The magnetic circuit. Magnetic properties of iron and steel. Calculations of resistance and magnetomotive force. Armature winding and connections.

III. Different kinds of machines—continuous and alternating. Calculations for the design of a continuous current bipolar machine. Limitations observed in first class design. Application of methods to multipolar machines.

IV. Construction of parts of machine—field magnets, armatures, commutators, brush-holders, brushes, &c.

V. Difficulties in the running of dynamos and means of overcoming them. Devices for reducing sparking. Methods of adapting machines to fulfil special conditions of supply.

VI. Practical charge of machines for central station work. Various systems of coupling machines together, and of arranging a network for general supply.

Cricket for 1897.—The secretary of the Joel-Pilsen Cricket Club is anxious to arrange matches with clubs connected with other electrical firms during the coming cricket season. Communications to be addressed to Mr. S. Snell, 31, Wilson Street, Finsbury Square.

Lectures.—On 15th inst. Mr. A. H. Gibbings, borough electrical engineer, lectured before the Bradford Scientific Association on "The Fundamental Principles of Electrical Apparatus."

Before the Harrogate Traders' Association, on the 19th inst., Mr. G. Wilkinson read a paper on the "Costs and Methods of Installing the Electric Light."

More New Rays!—The *Daily Chronicle* correspondent at Vienna says that Prof. E. Friedrich, of Elbing, Prussia, informs the Vienna Academy of Science that he has discovered some new kind of rays by which it is possible to determine definitely whether death has taken place. Prof. Friedrich maintains that these rays, which he calls "Kritikstrahlen," are so sharp, that they pass through the body almost in a moment, and produce pictures on the photographic plates differing according to whether the body is dead or living.

American Central Station destroyed by Fire.—Our trans-Atlantic contemporaries record a splendid piece of reconstruction work which has just been accomplished in Newark, N.J. The power-house of the People's Light and Power Company there was completely gutted by fire, every piece of electrical machinery being destroyed, including 37 dynamos and 7 engines, the steam-raising plant alone being saved. Within seven days there was set in position new plant of the Brush, Westinghouse, Fort Wayne, and Stanley Companies' manufacture, sufficient for every light in the city, *i.e.*, 14,000 incandescents and 1,650 arcs. While the fire was raging, some of the new plant was ordered by cable. The loss on engines and dynamos alone is estimated at $180,000. The president of the company (Mr. Jackson), and the superintendent (Mr. Gaffney), are to be complimented upon their smart piece of work.

The Heilmann Locomotive.—A correspondent says that the first of an improved Heilmann electric locomotive, built for the Western Railway Company, of France, was taken out for a preliminary trial on Thursday last week. The locomotive, which is capable of developing 1,350 H.P., is fitted with a Willans engine and Brown [illegible] dynamo.

Institution of Electrical Engineers.—The next students' meeting will be on Wednesday, February 3rd.

The Pender Memorial.—The Marquis of Tweeddale, on behalf of the committee, has signed a circular letter inviting support to the fund which is now being raised for this memorial. He states it has been decided by the committee that the memorial shall take the following forms, as funds permit:—1. That a bust of Sir John Pender be placed in a suitable institution in London, at a cost not exceeding £500. 2. That a sum of not less than £5,000 be placed in trust with the Council of University College, London, to form an endowment for the maintenance of the electrical laboratory in that College, on condition that the Council name the laboratory the "Pender Laboratory," and the existing Chair of Electrical Engineering the "Pender Chair of Electrical Engineering." 3. That a "Pender Scholarship and Gold Medal" in connection with electrical subjects be established in Glasgow. The whole of the fund, with the exception of £500, is to be devoted to technical education, and donations may be given either to the general fund, or specifically to one of the objects named above.

The Royal Society.—Papers were read yesterday afternoon as follows:—"On the Capacity and Residual Charge of Dielectrics as affected by Temperature and Time," by Dr. Hopkinson, F.R.S., and E. Wilson; "On the Electrical Resistivity of Electrolytic Bismuth at Low Temperatures and in Magnetic Fields," by Prof. Dewar, F.R.S., and Prof. Fleming, F.R.S.; "On the Selective Conductivity exhibited by certain Polarising Substances," by Prof. J. C. Bose.

Prof. Waller on Animal Electricity.—The second lecture of Prof. Waller's series was delivered on Tuesday at the Royal Institution. A good deal of it was taken up in an elaborate defence of the theories and terms employed in the opening discourse. There was shown first of all in the screen a muscle with the now familiar terms, T and L, shown in their relative positions. If he stirred up the muscle through its nerve, and made it contract, the place where it had the greatest capability for change was the point, L, which he had ventured to call zincable. If he arrested the action at point L by injury (which was done by a pair of scissors), he made L zincative, and if he injured the muscle at the point T, he would expect to get a current from T to L. Leaving this phase of the matter, the lecturer went on to a point that had been urged in the use of chloroform, that is, the use of nitrate of amyl would counteract the toxic effect of chloroform. Since the suggestion had been made to him, he had made experiments, but he could not find that nitrate of amyl was antagonistic to chloroform. That, of course, did not say that it might not produce some beneficial effect on the organism, if in danger of death from chloroform. It might assist the blood currents in brushing away the chloroform from the tissues. The paralysant action of nitrate of amyl upon the nerves would tend to keep the blood vessels narrow, and in that way it might be possible to gain slight beneficial effects in cases of chloroform poisoning. Then we returned to the terms again; the lecturer maintained that the electro-physicist used precisely the opposite terms, and turned the physiological nomenclature inside out; that is, he would say T was positive and L negative. He did not defend the words zincative and zincable, and he would be prepared to give them up to-morrow if he could be provided with a pair of words that would do duty for them. Then some few remarks followed upon the nerve current and the muscle current, that of the latter being 10 times greater than that of the nerve. A slight but interesting digression of the lecturer brought us to consider the effects of anæsthetics upon plant life. He showed two similar plants, one of which had been placed in chloroform vapour. The leaves of the anæsthetised plant were somewhat shrivelled and covered with dew, suggesting that the water had been drawn from the interstices, and that gave colour to the supposition that chloroform acted by the withdrawal of water from the protoplasm. That, however, as far as he was concerned, would remain an open question; but the supposition that chloroform arrested the oxidation that took place in the protoplasm would form the subject of a future lecture. The effect of chloroform on seeds had proved to be curious; similar seeds had been placed in separate jars, and while one set had germinated, the others, which had been under the action of chloroform, had remained passive.

Left Over.—Owing to pressure upon our space, we are compelled to hold over a letter by Dr. Augustus Waller on "Electrical Terms Used by Physiologists" until next week.

NEW COMPANIES REGISTERED.

General Electrical Company of Roumania, Limited (50,989).—Registered on January 22nd with a capital of £3,000, in £1 shares, to manufacture, construct, erect, lay down, establish, fix, maintain, buy, sell and deal in all machinery, engines, rolling stock, cables, wires, lines, accumulators, lamps, apparatus, &c., connected with electricity. The subscribers (with one share each) are:—E O. Goss, Vestry House, Laurence Pountney Hill, E.C., solicitor; W, R. Smith, 61, Clifden Road, Clapton Park, N.E, clerk; F. W. Boorman, 9, Woodville Terrace, Gravesend, solicitor; F. W. London, Vestry House, Laurence Pountney Hill, E.C., clerk; A S. Chanter, 56, Pascoe Road, Lewisham, clerk; F. A. Stonier, 18, Griffin Street, Lambeth, S.E., clerk; C. M. Leitch, 11, Baltic Chambers, Bishopsgate Street, E C., secretary. The number of directors is not to be less than two, nor more than seven; the subscribers are to appoint the first. Qualification £100; remuneration 1 guinea each per board meeting attended.

Chislehurst Electric Supply Company, Limited (50,980).—Registered on January 22nd, with a capital of £15,000 in £5 shares, to carry on the business of electrical engineers and contractors, electricians, manufacturers of electrical apparatus, mechanical engineers and suppliers of electricity. The subscribers (with one share each) are:—W. L. Thornton, The Common, Chislehurst, gentleman; C. Balme, Fairlight, Chislehurst, wool broker; R. B. Martin, M.P., J.P., Chislehurst; A. T. Hawes, Nizels, Chislehurst, solicitor; H. James, Holly Bowers, Chislehurst, gentleman; P. Nicholls, Knight, Fallowfield, Chislehurst; H. J. Hadrill, Millfield, Chislehurst, gentleman. The number of directors is not to be less than three nor more than seven. The subscribers are to appoint the first; qualification, one share. Remuneration as fixed by the company.

CITY NOTES.

Londonderry Accounts.

Mr. J. Christie, the City Engineer, has sent us the following accounts, showing the cost of lighting for one year and 24 days ending November 24th, 1896. The works were started May 29th, 1894:—

Loans sanctioned.	Amount borrowed.	Rate.
£18,942 6s. 4d. ...	£18,942 6s. 4d. ...	3½ per cent.

£843 13s. capital paid as out of revenue account.

Capital expended November 24th, 1896 ...	£19,785 19s. 4d.
Capacity of plant	180 kw.
Number of 500-watt arc lamps	174.
Estimated number units generated ...	273,121
Total works' cost per lamp per annum ...	£12 13s. 4d.
Total costs per lamp per annum	£21 1s. 3d.

Street lighting only at present, no fixed charge. Revenue = total expenditure.

At 12.0 midnight half lamps extinguished, and during winter months these are re-lighted from 5.30 a.m. till daylight.

Works' Costs.

	£	s.	d.	Per unit.
Coals	520	17	10	·45
Oils, &c.	101	13	3	·08
Carbons	295	6	2	·25
Wages	714	18	1	·62
Repairs and maintenance ...	258	6	4	·22
Works' cost	1,891	1	8	1·66
Rents, rates and taxes	72	11	6	·06
Management and office expenses	240	17	4	·21
Total works' cost ...	2,204	10	6	1·93
Interest and sinking fund ...	1,460	13	4	1·28
Total expense ...	£3,665	3	10	3·22

The Bristol Corporation Accounts.

The Electricity Works Department of the Bristol Corporation have turned the corner in splendid fashion. Last year they had a deficit of £2,885, but on the actual year's working for 1896 they show a profit of about £488. There is a balance from the last account of £1,768—surplus of money borrowed from rates—which now makes the balance to be carried forward £2,274. The figures for the past three years show how significant the progress has been:—

	Deficit.	Profit.
1894	£4,090	—
1895	£2,885	—
1896	—	£480

It must not be forgotten that over £7,000 per annum is paid away in the shape of interest on mortgage debt and instalment of money borrowed, and up to the present it has been necessary to call upon the rates to meet the deficit on the working.

Towards the end of 1895 considerable extensions were made on the system, and it was anticipated by the Electric Lighting Committee that no further calls upon the rates would be necessary, and this expectation has been amply borne out by the results.

A comparison of the cost of production in 1896 with that of the previous year shows a decrease in the total cost per unit of ·68d., with an increased output of 242,459 units.

	1896.	1895.
Total capital invested	£110,000	£100,000
Number of units sold	650,758	408,301
Number of lamps connected	—	—
Revenue from sale of current, &c. ...	£10,726	£9,270
Net revenue	£7,590	£4,020
Average price obtained per unit ...	5·26d.	5·46d.

Cost of production.	£	Per unit.	1895.
Coal	2,068	·76d.	·97d.
Oil, waste, water and engine room stores	214	·08d.	·09d.
Salaries and wages at generating station	1,442	·53d.	·74d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	791 (Works' cost 1·66d.)	·29d.	·17d.
Rates and taxes	1,019	·37d.	·61d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	1,341	·49d.	·62d.
Depreciation of buildings and plant account	—	—	—
Renewal fund account	—	—	—
Total	£6,875	2·52d.	3·20d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	10,726	0	0	5·26d.
Public lighting	3,680	0	0	—
Meter rents	487	0	0	—
Sale of lamps	87	0	0	—
Total	£14,980	0	0	5·26d.

Total cost per unit (exclusive of depreciation and renewal accounts), 2·52d.; works' cost, 1·66d.

The Coventry Electric Tramways, Limited.

The directors' report states that the result of the working of the line has been satisfactory, and the running of the cars, both as regards punctuality and speed, has been very good. During the year the cars have run 215,416 miles, and have carried 1,196,939 passengers.

The profit for the year, after paying debenture interest, directors fees, and income-tax, has been ...		£2,584 3 0	
and in addition to paying a dividend on the preference shares, absorbing	£885 0 0		
they have been enabled to pay a dividend of 8 per cent. on the ordinary shares, absorbing ...	786 13 4		
		1,671 13 4	
Leaving to be carried forward the sum of		£912 9 8	

City and South London Railway Company, Limited.

The twenty-fifth ordinary general meeting of the proprietors of the above company was held yesterday, at Winchester House, Mr. C. G. Mott presiding.

The Chairman, in moving the adoption of the report, said it was the most satisfactory one that had been presented since the opening of the railway. During the past half-year there had been a very steady and satisfactory improvement in the traffic at all times of the day. That was partly to be accounted for by the increased facilities which they had been able to give in consequence of the alterations at the King William Street Station. During the half-year they had been able to run 1,314 more trains during the busy hours of the day, which had undoubtedly had something to do with the increased traffic. It was evident that the public were getting more and more confidence in the working of the railway, and in the feeling that it was to electric railways they would have to look in the future for the best mode of locomotion which had yet been introduced into the metropolis. There had been an increase in the passengers carried over those of the corresponding period last year of 196,042, and an increase in the receipts from passengers of £1,707. The condensing plant was now in full working order, and it had

proved a very decided advantage, both in economy, and in enabling them to deal with the increasing and heavy traffic that they had to carry. They had made improvements in the carriages, and they intended to go on improving them. They were endeavouring to build better and more powerful engines, having in view the extension of the line, and the increased length of the trains they would have to carry, and, if possible, they desired to increase the speed of the trains. The extension to Moorgate Street was going on satisfactorily, and in that connection he could not help saying that he considered it a very unfortunate decision, for the public, that was come to by Parliament, by which they were compelled to build their station underneath the Church of St. Mary Woolnoth so as not to touch the fabric. By that decision, he considered that the spiritual needs of hundreds of thousands of persons, and the convenience of the travelling public to the extent of millions and millions of people in the future, had been sacrificed for the self-glorification of one or two individuals, and for the fads of a few second-rate architects. The board greatly regretted the death of Mr. Greathead, who had been associated with the undertaking from its commencement. He was the first man to patent and develop the particular mode of construction of the tunnels—the shield system—which had rendered possible and practicable the construction of so many underground railways now contemplated, for the future advantage of the public. He was an engineer of great ability, and was rapidly rising in his profession, and it was a very sad thing to see him cut down in the prime of life, just when he was on the point of achieving great success. They had secured in his place the services of Sir Benjamin Baker, who practically stood at the head of his profession. The directors intended to proceed with the extension to Clapham, and for that purpose they would ask the shareholders to authorise the issue of 5,000 preference shares. They did not intend to press forward with the extension more than was necessary to get it opened some time after they had got the extension to the City in working order. They had no present intention of issuing the shares, but they wanted to be in the position of being able to take advantage of the most favourable opportunity for doing so. Turning to the balance-sheet, he said that, as compared with the corresponding half-year, the passenger receipts showed an increase of £1,676, which with other items made a total increase of £1,728. On the other hand, there was a total increased expenditure of £291—not a very large sum to place against the increased receipts. They proposed to pay a dividend of 1¾ per cent., and to carry forward £1,313 to the next account. The working expenses of the railway pure and simple—excluding the cost of the lifts—had been reduced to 49·25 per cent., against 51·50 per cent. last half-year. The receipts per passenger had increased from 1·80d. to 1·87d., so that they had nearly got up to the uniform fares of 2d. with which they started. The locomotive expenses per train mile had been reduced from 6·02d. to 5·65d., which was a very low figure. Although hitherto those who had placed their money in the company had only received a poor return upon their capital, they had the satisfaction of knowing that they had been instrumental in introducing a system of locomotion which would be to the advantage of humanity at large, but he believed that those shareholders who held to the company would yet get an adequate return on their investments, and that they would prove that electric traction was not only by far the best mode of locomotion, but that it would also be the most remunerative in the end.

Mr. SAMPSON HANBURY seconded the motion, which, after a short discussion of a complimentary character, was carried.

Direct United States Cable Company, Limited.

THE half-yearly meeting of this company was held on Tuesday, at Winchester House, presided over by Mr. E. M. Underdown, Q.C.

The CHAIRMAN, moving the adoption of the report and accounts to December 31st last, said that their prospects for the current year were most encouraging, and they might become so prosperous in the current half of the year, that they might find themselves in a position to offer something additional to the proprietors. He merely threw this out as a hint, because he did not wish them to run away with the idea that such a result would be achieved. They would find on the whole, he thought, that the position of the company was not unfavourable. The revenue, after deducting payments, amounted to £47,600, and the working and other expenses, exclusive of cost of repairs of cables, to £19,815, leaving a balance of £27,785 as the net profit, making, with £4,235 brought forward, a total of £32,021, which would be appropriated to the payment of two interim dividends of 2s. 6d. each, which would absorb £15,177, and after placing £12,000 to reserve, the balance of £4,843 would be carried forward. The increase in the revenue during the half-year, as compared with 1895, amounted to £3,663, or more than 8 per cent. Most of the items in the accounts remained pretty much the same as they were last half-year. There were one or two increases, but these comprised the fair increases to the deserving members of the staff, and were more than covered by the freedom which the company now had from an item respecting the use of patents, which now ceases to appear in the accounts. The cost of cable repairs had only been £529, which sum had been debited as usual to reserve fund account. The investments had been increased by £18,166 since June last, their present market value being about £58,000 more than the figure at which they stood in the accounts. During the six months they had not been untroubled by external events. They would be very glad indeed if they and their companions in the pool could be the proprietors of the only cable across the Atlantic, but they were being perpetually threatened by additions to the number of cables at the bottom of the sea, which was amply sufficient to carry the traffic between Europe and America. They were aware that they had arrangements with the other companies, one of which—the Anglo—was at present working the German traffic from Emden to Valencia, and from Valencia across the Atlantic. That agreement would in a short time come to an end. The effect of that would be that if the German Government took steps to establish for itself a cable, or cables, there was no doubt that the pool would be lost; or, in other words, the amount of guaranteed traffic as a minimum, which went to the pool companies, would be lost. With regard to that, they had recently heard that a cable had been completed from Emden to the coast of Spain. There was also a cable which reached to the Azores, and they and the pool companies had had it under their serious consideration twice, and since his (the speaker's) election to the chair, as to whether they or the pool companies, or all together, should deal with the extension from the Azores to the American coast. This, being a German concession, was one which they must assume the German Government would be inclined to treat as their system, connecting, as it did, their country with America, notwithstanding that it was a very round-about route. When it was first presented to them they found that, looking at it as a scheme, they could not possibly either adopt it themselves or join with the pool in doing so. Latterly they had looked at this matter again very attentively, in accord with the allied companies, and they had come to the conclusion that the conditions under which it was presented to them, and the advantages which were supposed to arise from it, did not justify them in taking up the scheme. Nor had it, he believed, been taken up in other quarters, and they had the satisfaction of knowing that none had found it worth their while to take up the scheme in rivalry to themselves. The reserve fund was not so high as 12 years ago, but they must prepare for emergencies. In conclusion, he referred to the breakage by a vessel of their cable at Ballinskelligs, the repairs to which entailed an expenditure of nearly £600. The question of the liability of the owners of the vessel was occupying the board's attention. Last week they heard that the short section between Halifax and the U.S. was not working satisfactorily. A ship of the Anglo Company's was by at the time, and they engaged her. Instructions were sent on Thursday night for the ship to carry out the repairs, and before 2 o'clock on Saturday a message was received, saying that the cable had been taken from the bottom (a depth of about 100 fathoms), repaired, and was working satisfactorily.

The motion was seconded by Mr. J. PENDER, M.P.

Capt. GOODSAL considered that as the damage to the cable occurred within 200 yards of the shore, £600 was a great deal too much for repairing it.

The CHAIRMAN, in reply, pointed out that under all the circumstances the charge was not excessive, as they had to get a ship, which had to be paid for, in addition to which they had to replace a large piece of cable.

The report and accounts were then adopted, and after the sum of £250 had been voted to the Pender memorial, the usual vote of thanks closed the meeting.

Eastern Telegraph Company, Limited.

THE half-yearly general meeting of this company was held on Thursday last week at Winchester House, the Marquis of Tweeddale presiding.

In moving the adoption of the report, the CHAIRMAN stated that the gross revenue for the half-year ended September 30th last had amounted to £435,465, being an increase of £25,685 over that of the corresponding period of 1895. This was chiefly owing to exceptional circumstances. The traffic between Italy and Perim was temporarily augmented owing to the Italian military operations in Abyssinia, but this traffic had now resumed its normal proportions. The increase in the Australian traffic, through the activity in gold mining enterprises in Western Australia, was being fairly maintained, and so long as the present activity went on the same satisfactory results might be looked for, but they could hardly expect the present increase to be a permanent one. During the past 10 or 12 years their traffic had shown a steady and satisfactory increase, excepting that between India and Europe. The practical stagnation of their Indian business was unsatisfactory, and appeared to him to justify the company's indisposition at the late Buda Pesth Conference to make the reduction which was then pressed upon them. The total amount of their ordinary expenses in the half-year had been £102,376, being an increase of £5,672 as compared with the expenses of the September half of 1895, but in the present half-year's accounts there were two special items amounting to about £2,000. They had entered into an arrangement with the patentees for the introduction of an automatic system of signalling instruments for working cables, which they believed to be of great value. When their staff were thoroughly acquainted with the working of the new system, a considerable increase of speed in the transmission of messages would be attained, and the service would be rendered even more efficient than it was at the present time. The notable feature in connection with the expenses was the large decrease of £25,044 in the repairs and renewals of cable, as to which they had been particularly fortunate in the past half-year. They had carried to the general reserve fund £25,000 more than in the corresponding period of 1895, thus increasing this fund to £646,982, and they had made a further addition to their maintenance ships' fund and fire insurance fund. They had also been enabled to start a new fund for depreciation against the large expenditure on account of land and buildings. They had paid the usual interim dividend of 2s. 6d. per share, and they had no reason to doubt that they would be able to recommend the payment of a bonus at the end of the current year of the same amount as last year. The traffic receipts on the Emden-Vigo cable had been very satisfactory, considering the short time it had been in operation. The principal modifications made at the Buda Pesth Conference in the rules in force affecting the general public

would be the counting of five figures as one word in extra-European correspondence instead of three. This change would come into force on July 1st next, as well as certain reductions of tariff. Thus, their rate to Spain would be reduced from 4½d. to 4d. per word, to Portugal and Gibraltar from 5½d. to 4½d., and from Great Britain to Greece from 6½d. to 6d. per word. They had also been enabled to arrange a long-standing difference as regarded the tariff with Tripoli. Lastly, the tariffs between Europe and Mauritius and the Seychelle Islands would be reduced to 5s. per word, placing these colonies on the same footing as South Africa. They had been assisted in making these changes by the several Governments interested, and their relations with the Governments of all the countries with which they were connected telegraphically were most cordial. They had decided on subscribing £250 to the Indian Famine Relief Fund. The only question with the directors was whether this amount would be considered sufficient by the shareholders.

After a short discussion the resolution was agreed to. Subsequently it was decided to increase the company's contribution to the Indian Famine Relief Fund to £500.

The Liverpool Overhead Railway Company, Limited.

IN presenting the half-yearly statement of capital and Revenue accounts to December 31st, 1896, the directors report that the gross revenue receipts amount to £32,782 18s., and the working expenses to £20,954 10s. 5d. The number of passengers carried during the last two years is as follow:—

	Half-year ending June 30th, 1895.	Half-year ending Dec. 31st, 1895.	Half-year ending June 30th, 1896.	Half-year ending Dec. 31st, 1896.
First class ...	400,260	444,762	455,561	476,817
Second class ...	2,114,462	2,374,794	2,284,823	2,473,828
Workmen (special return tickets) ...	945,338	960,819	999,191	968,489
Total ...	3,460,060	3,780,375	3,739,575	3,919,134

These figures show a continued and steady increase in the traffic.

The directors report that the southern extension to the Dingle was opened on December 31st last, and they have every reason to think it will prove a satisfactory source of revenue to the company.

REVENUE ACCOUNT.

Receipts from passenger traffic amount to ...	£32,227	2	3
Miscellaneous receipts	555	15	9
	£32,782	18	0
Less working expenses and interest ...	21,003	5	5
	£11,779	12	7
Deduct interest on mortgage debentures ...	2,500	0	0
	£9,279	12	7
Add balance brought forward, June 30th, 1896	2,897	12	5
Leaving available for dividend	£12,177	5	0

Out of this balance your directors recommend the declaration of dividends at the following rates (less income-tax), payable on and after February 12th, viz.:—

5 per cent. per annum on preference shares ...	£2,700	0
3 „ „ ordinary shares ...	£6,412	10

leaving a balance of £3,064 15s. to be carried forward to next half-year.

City of Birmingham Tramways Company.

THE first ordinary general meeting of the City of Birmingham Tramways Company, Limited, was held on the 21st inst. at the Queen's Hotel, Birmingham. Mr. W. Mackenzie presided.

The CHAIRMAN said the meeting was held merely in compliance with the terms of the Companies Acts, and no business would be transacted. The annual meeting would take place as soon as possible after the close of the financial year, and then all matters affecting the company would be considered. The Chairman said the whole of the capital of the company has not been issued, but the calls on the whole of the capital issued had been paid.

A general meeting was afterwards held for the purpose of considering resolutions approving of the company's Bill now before Parliament and making one or two alterations in the articles of association.

Mr R. H. MILWARD, solicitor to the company, explained that the Bill was to authorise the construction of the tramways, of which notice had appeared in the newspapers, and also to authorise the company to convert the existing tramways and construct the new tramways upon lines of electric traction, subject to agreement as to details with the Corporation of Birmingham and the other authorities. There was no opposition to the Bill on the Standing Orders, and the matter would go forward, but it was necessary to have the approval of the shareholders under the Standing Orders by special resolution.

Anglo-American Telegraph Company, Limited.—The directors of the company have resolved, after placing the sum of £12,000 to the credit of the renewal fund, to recommend at the next ordinary general meeting of the company, to be held on February 5th next, the declaration of the following dividends:—A balance dividend of 17s. per cent. upon the ordinary consolidated stock for the year ending December 31st, 1896. A balance dividend of £1 14s. per cent. upon the preferred stock for the year ending December 31st, 1896, both payable on February 6th next, less income-tax, to the stockholders registered on the books of the company on the 19th inst. After paying the foregoing dividends, there will be a balance of about £360 to be carried forward to the next account. The above dividends, together with those already paid, will amount to £2 13s. per cent. on the ordinary consolidated stock, and £5 6s. per cent. on the preferred stock, for the year 1896. The register of transfers will be closed from January 22nd to February 5th, both days inclusive.

The Dublin United Tramways Company, Limited.—The directors of the above company have declared a dividend for the half-year ending December 31st, 1896, at the rate of 6 per cent. per annum on the 6 per cent. preference shares of this company, after providing debenture interest and after paying interest, amounting to £3,810, on the unpaid purchase money of the Dublin Southern District Tramways Company from July 1st to December 1st, when the purchase was completed. A balance remains of £1,930, and as the ordinary shares were only paid up a few weeks before the end of the half-year, the directors propose to carry the entire of this balance forward to next half-year.

Dublin United Tramways (Old) Company, Limited.—Subject to final audit, the directors of the above company recommend the payment of a dividend of 5 per cent. per annum, free of income-tax, for the half-year ending December 31st, 1896, on the share capital of the Old Dublin United Tramways Company, after writing off £500 from horse account, charging against revenue the balance of costs of the opposition to the Dublin Southern District Tramways Bill, and of the order in Council of 1896, and setting aside £3,000 towards further reconstruction of lines, and carrying forward to next account a balance of £2,021 5s. 7d.

Stock Exchange Notices.—The Stock Exchange Committee have appointed Wednesday, February 3rd, a special settling day in British Electric Traction Company, Limited—20,000 ordinary shares, Nos. 1 to 20,000, and River Plate Electric Light and Traction Company, Limited—£125,000 5 per cent. first debenture stock, and ordered British Electric Traction Company, Limited—20,000 ordinary shares, Nos. 1 to 20,000 to be quoted in the Official List.

Application has been made to include in the Official List, Metropolitan Electric Supply Company, Limited—Further issue of £70,000 4½ per cent. first mortgage debenture stock.

National Telephone Company.—The directors have resolved to recommend, subject to final audit, the following dividends for the half-year ending December 31st, 1896:—At the rate of 6 per cent. per annum, less income-tax, on the amounts paid up on the first and second preference shares; at the rate of 5 per cent. per annum, less income-tax on the amounts paid up on the third preference shares; at the rate of 6 per cent. per annum, free of income-tax, on the amounts paid up on the ordinary shares; carrying £35,000 to reserve, and about £6,000 forward.

The Eastern Extension, Australasia, and China Telegraph Company, Limited.—This company announces that the interest on the 4 per cent. mortgage debenture stock for the half-year ended January 31st inst. will be paid by warrant on February 1st next. The stock register will be closed from the 27th to the 30th inst., both days inclusive.

Venezuela Telephone and Electrical Appliances Company, Limited.—Coupon No. 13 of the 5 per cent. mortgage debentures, due on 31st inst., will be paid from that date at Parr's Bank, 52, Threadneedle Street, and at Messrs. Westendorp & Co.'s Bank, Amsterdam.

Waterloo and City Railway Company, Limited.—The directors in their report for the past half-year state that the accounts show an expenditure of £67,337, making the total outlay £280,526. The fourth call of £2 per share is payable on February 1st.

Coventry Tramways Company, Limited.—The annual meeting was called on Monday at Coventry, but owing to the absence of the necessary quorum, was adjourned for a week.

New York Edison Company, Limited.—A financial daily states that the result of the working of the Edison Electric Illuminating Company of New York last year was an increase in the surplus, after allowing for dividends, of $98,267.

St. James's and Pall Mall Electric Light Company, Limited.—The share transfer books will be closed from January 25th to February 8th, inclusive.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending January 24th, 1897, were £1,115; week ending January 26th, 1896, £994; increase, £121; total receipts for half-year, 1897, £4,398; corresponding period, 1896, £4,035; increase, £363.

The Liverpool Overhead Railway Company. The receipts for the week ending January 24th, 1897, amounted to £1,217; corresponding week last year, £1,043; increase, £147.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending January 22nd, 1897, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,753.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, Jan. 20th.	Closing Quotation, Jan. 27th.	Business done during week ended Jan. 27th, 1897. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	8½— 9½	8½— 9½	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 2s.	£2 9s.	...	53 — 56	53 — 56	55½	54
2,993,560£	Do. do. 6 % Pref.	Stock	£4 4s.	£4 18s.	...	97½— 98½	97½— 98½	98½	97½
2,993,560£	Do. do. Defd.	Stock	...	...	...	10½— 10⅝	9½— 10	10⅛	9½
139,000	Brazilian Submarine Teleg., Ltd.	10	7 %	7 %	...	14⅝— 15½	15 — 15½	15½	15
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	113 —117	113 —117	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	2½%	4 %	...	3½— 3⅝	3½— 3⅝	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	...	160 —170	170 —175	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	1½%	...	1/16— 1/8	1/16— 1/8	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	...	12 — 13	12 — 13	13	12½
6,000	Do. 10 % Pref.	10	10 %	10 %	...	18½— 19½	18½ — 19½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	...	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	10 — 10½	10 — 10½	...	...
80,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	4½%	4½%	...	105 —108%	105 —108 %	...	...
60,710	Direct United States Cable, Ltd.	20	2 %	2½%	...	9½— 10	9½— 10	9⅞	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	...	17 — 17½xd	17¼— 17⅝	17½	17¼
70,000	Do. 6 % Cum. Pref.	10	6 %	6	...	18 — 19 xd	18 — 19	18⅝	18⅛
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	...	104 —107	104 —107	105	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	127 —130	129 —132	129½	128⅝
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	...	17¼— 17⅝xd	17½— 18	17⅝	17½
54,100£	{ Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	}100	5 %	5 %	...	100 —104	100 —104	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	...	101 —104	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	128 —131	130 —133	130	...
80,600£	{ Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	}100	5 %	5 %	...	100 —104	100 —104	...	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	101 —104	101 —104	...	...
300,000£	{ Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	}100	4 %	4 %	...	108 —111	108 —111	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	...	109 —112 %	109 —112 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	...	10⅝— 11¼	10⅝— 11¼	11	...
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	17¼— 17⅝	17¼ — 17⅝	17⅝	17 5/16
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜%	10 %	...	24½— 25½	24½ — 25½	...	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	104 —107	104 —107	105½	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	...	53 — 56	53 — 56	...	...
100,000£	London Platino-Brasilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 %	5½%	...	7½ — 7⅝	7⅝— 8	7⅞	7 9/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	17 — 19	17 — 19	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	17 — 19	17 — 19	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	...	6⅜— 7	6⅜— 7	6⅞	6⅜
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	...	105 —108	105 —108	105½	105¼
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	4½%	5 %	...	11/16— 13/16	11/16— 13/16	...	...
100,000£	{ Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	}100	4 %	4 %	...	106 —109	106 —109	...	...
11,839	Reuter's Ltd.	8	*nil*	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	138 —143	138 —143	140	139
58,600	United River Plate Teleph., Ltd.	5	3 %	4 %	...	3½— 3⅝	3½— 3⅝	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	100 —105	100 —105	100½	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	4 %	...	5 — 6	5 — 6	...	...
238,380£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	103 —106	103 —106	...	...
38,000	West Coast of America Teleg., Ltd.	10	*nil*	*nil*	...	0 — 1	0 — 1	...	...
150,000£	Do. do. do. 6 % Debs., repay. 1902	100	8 %	8 %	...	92 — 98	93 — 99	...	...
64,248	Western and Brazilian Teleg., Ltd.	15	3 %	3 %	...	8½— 8⅝	8⅝— 9¼	8⅞	...
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	...	6½— 6⅝	6⅝— 7¼	7¼	6½
33,129	Do. do. do. Def. Ord.... ...	7½	1 %	1 %	...	2½— 2⅝	2⅝— 3½	3	2⅝
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red.	100	6 %	6 %	...	106 —110	110 —114	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	...	106 —110	109 —113	...	...
88,321	West India and Panama Teleg., Ltd.	10	1⅝%	1⅝%	...	1½— 1⅝	1½— 1⅝	1 3/16	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	11½— 12	11½— 12	11⅝	11½
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	9½— 10½	9½— 10½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	...	107 —110	107 —110	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	...	107 —112	107 —112	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	5 %	...	9⅜— 10½	9⅜— 10½	9⅞	9 1/16
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	...	8½— 9	8½— 9	8 1/16	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	4½%	...	112 —115 xd	112 —115	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	5 %	5 %	...	15½— 16½	15½— 16½	16½	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	16½— 17½	16½— 17½	...	...
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	128 —132	128 —132	132	...
22,475	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	...	*nil*	...	8 — 9	8½— 9½	9	...
20,000	Do. do. do. 6% Pref., 40,001—50,000 ...	10	...	6 %	...	13½— 14	13½— 14	14	...
10,000	Do. do. do. iss. at 2 pm., all paid	10	...	...	...	9½— 10½	9½ — 10½	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	3 %	4 %	...	13 — 14	13 — 14	14	13⅝
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem., £1 paid	10	...	...	...	6⅝— 7¼	6⅝— 7¼	7	...
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	119 —122	119 —122	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	1 %	2 %	...	11 — 12	11 — 12	...	...
12,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	6½%	7½%	10½%	13 — 14	13 — 14	13⅞	13½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9½— 10½	9½ - 10½	...	...
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	5 %	7 %	...	11 — 12	11½— 12½	12⅜	11⅜

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation Jan. 20th.	Closing Quotation, Jan. 27th.	Business done during week ended Jan. 27th, 1897. Highest.	Lowest
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000	S	2½%	...	...	⅜ — 1	⅞ — 1⅛	1	⅞
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	...	...	1⅛ — 1⅜	1¼ — 1½	1⅜	1 1/16
125,000£	Do. do. 4½ % Perp. Deb. Stock.	Stock	4½%	...	...	109 —112	109 —112	109	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	94 — 98	94 — 98	...	...
9,104	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10¼	9⅜— 10¼	10⅛	...
207,649	Do. do. do. £4 paid	10	...	...	...	3¾— 4	3¾— 4	3 15/16	3⅞
630,000£	City and South London Railway	Stock	1½%	1 3/16%	1 9/16%	58 — 60	59 — 61	59⅝	59
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	*nil*	...	1⅜ — 2⅛	1⅜ — 2⅛	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	5 %	5 %	...	1⅜ — 2⅛	1⅜ — 2⅛	1⅜	...
17,139£	Do. do. do. "A" Shares 01—017,139	5	5 %	5 %	...	3 — 4	3 — 4	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	4½%	4½%	...	105 —110	105 —110	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	5 %	...	1⅜ — 1⅝	1½ — 1¾	1 11/16	1⅝
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	...	2½ — 3	2½ — 3	2⅝	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	...	...	⅝ — ⅝	⅝ — ⅝	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	...	...	¼ — ¼	¼ — ¼	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	10½%	...	10½— 11½	10½— 11½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	6 %	8 %	...	17½ — 18½	18 — 19	...	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	...	18½ — 19½	18½ — 19½	18⅝	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	4½%	...	109 —114	109 —114	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	...	20½— 21½	20½— 21½	21½	20⅞
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	106 —109	106 —109	107	...
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	2⅜%	...	14 — 14½	13½— 13½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	...	16½ — 17	16½ — 17	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	...	40 — 43	40 — 43	42	40½
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	...	102 —105	102 —105	...	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ...	10	...	...	...	7½ — 8	7½ — 8	7⅞	7 15/16

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
CROMPTON & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7½%; 1890—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 9½.
Electric Construction Corporation, 6 % Debentures, 102—105 xd.
House-to-House Company (£5 paid), 4½—5.
Do. do. 7 % Preference, of £5, 8⅜—9½.
Do. do. 4½% Debentures of £100 107—109 xd.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 10½—10⅝; 1st Preference Cumulative 6 %, £5 (fully paid), 8½—8⅝.
London Electric Supply Corporation, £5 Ordinary, 1—1½.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 6¾—7½.

* From Birmingham Share List.

Bank rate of discount, 3½ per cent. (January 21st 1897).

THE WONDERFUL EXPANSION IN THE USE OF ELECTRIC POWER TRANSMISSION.

DISCUSSING this subject in the *Engineering Magazine*, Dr. Louis Bell reviews in abstract the history of electric transmission of energy. Just a quarter of a century ago the Gramme dynamo gave a great impetus to electrical work generally, and in 1873 the first modern type motor was run at the Vienna Exhibition. It worked a pump through a mile of cable, but real commercial operation took until 1878 to get under weigh. It was in that year that Messrs. Chretien and Félix put in a motor to work a beet sugar hoist to unload beet from barges, and the result was a saving of 40 per cent. as compared with handwork. In 1879 was seen the first electrical railway at the Berlin Exhibition. There were a few arc light circuits established, and small motors began to appear in the year 1880, and by 1884 the electric motor was firmly established. In 1882, at the Munich Electrical Exhibition, Marcel Deprez transmitted power 37 miles from Miesbach by common telegraph wires to the extent of half a horse-power. The voltage of the dynamo was 1,350, and this, as well as the motor, were specially wound Gramme machines. By the autumn of 1886 some 5,000 motors were in use in the United States, and nine electric railways running 58 motors. Incandescent lighting stations then began to grow numerous.

It was not until 1890 that power transmission can be said to have been commercially successful, but the motor, then recognised as a reliable and practical machine, began to be adopted in the mining regions of the Western States. Till then high voltages had been looked upon with fear in America, and only in 1891 did current of 1,800 volts at Dalmatis, Min., Cal., and of 3,000 volts at Telluride, show what was possible. This was at the time that 10,000-volt installations were under weigh in England. Brush machines were used at Dalmatis, and a single synchronous motor at Telluride. In 1891 came the Frankfort Exhibition giving a final impulse, and in 1892 came much work, notably the 12½ miles Bodie transmission scheme in California, while a long distance light plant was organised for the towns of Pomona and San Bernardino, distances of 13¾ and 28¾ miles from the source of power in San Antonio Canon. The voltage was 10,000, and Dr. Bell says this was the first commercial use for so high a voltage. He might have added in America, and been more correct in his statement. It is noted as a curious fact that in 1893-4, when industry was almost paralysed, electrical transmission grew apace. This he attributes to the fact that electricity offered a means of reducing expenses, and therefore being hard up for remunerative return of capital, people endeavoured to save expenses where they could not make profits. In these years two cotton mills were electrically driven at Columbia and at Gelzer, N.C., with polyphase motors applied to groups of machines, and dispensing with much belting and shafting. Then came the Folsom Sacramento plant, and finally the large Niagara installation, delivering 1,000 H.P. over 27 miles to Buffalo.

Then to-day there are 13,000 miles of electric line in the United States, with 30,000 motor cars of a million horse-power, and generating plant of half a million.

Mileage is still growing; nearly 2,000 miles was the growth of last year, and for stationary work the electric motor is fast making headway. The adverse times have done much to effect this, while the high price of fuel in the cities has also helped the industry forward. Electrical power may, in itself, be dear, as compared with steam power; but it is cheap in its elimination of costly intermediaries. Shafting is ravenous of power. Electricity can be applied with but little shafting. In England we cannot hope for much in the way of water-power. What water powers we have are small, and the case of Foyers, where a natural beauty was threatened, only shows how few must be our falls, when even Foyers had to be sacrificed. But there is a waste of power going on just as available for use as a fall of water. We mean in the enormous outpourings of gas from the many iron works of the country. Gas of many thousand horse-power runs practically to waste, and yet the outlay of capital necessary to save it

is small in comparison with the outlay necessary to secure and utilise a water power. There is absolutely no reason why we should not now have just as big an advance as the Americans. We talk of competition, yet we don't know it as the Americans do. Perhaps it is that manufacturing is still so profitable that people are not urged to save as they have been during bad times in America. As regards saving to be effected, one of the mining plants has paid 5 per cent. per month in its electrical outlay.

The future is bright, and will see enormous growth of railway work, and when the public wants 100 miles per hour it can have it electrically, with but little more experimenting. City congestion will be checked.

Dr. Bell says that there are enough unemployed water powers within 50 miles of New York to displace every steam engine in the city. No fears can now be entertained of long distance work with the 35 miles example at Fresno or the Niagara scheme.

Apart, however, from water power, there is the use of coal at the pit mouth, and the transmission of the energy electrically. This was Mr. Thwaite's scheme, but our opinion of this is not so hopeful as his other gas scheme we have referred to previously. The city may be freed from smoke, but what of the new city which will grow up round the power plant. The people there would become a sort of social pariah. To be cleanly and effective, we think gas power must be used, and clean gas produced for gas engines, saving the tars and ammonia.

Altogether, Dr. Bell's paper gives rise to much thought and to many hopes. The United States stands an easy first in power utilisation at present, but it is our own fault if our own waste energies do not soon prove to us what water power has proved to the Americans.

NEW ARC LAMP TRANSFORMER.

We illustrate herewith a form of transformer made by the Brush Electrical Engineering Company, Limited, to the designs of Mr. W. M. Mordey. The particular form of case illustrated is suitable for post or wall, but the general arrangement is, of course, applicable in other ways. The transformer itself is of the ordinary Mordey-Victoria type, but a point of interest is in the manner in which provision is made to prevent any possibility of danger. The transformer is provided with a switch operated from the outside by a key. This switch is of the quick-acting, double-pole, double-break, type, and is well seen in plan in one of the illustrations. The primary high tension double-pole fuses are carried on the cover or door, and are mounted in such a way that the opening of the door disconnects the fuses and their fittings from the circuit even if the transformer has not been switched off. In this way the possibility of the attendant receiving any shock when examining or replacing the fuses is entirely avoided. This is a point of some importance, especially in cases such as are common in the colonies where the transformers are placed on a wall or post in an exposed position.

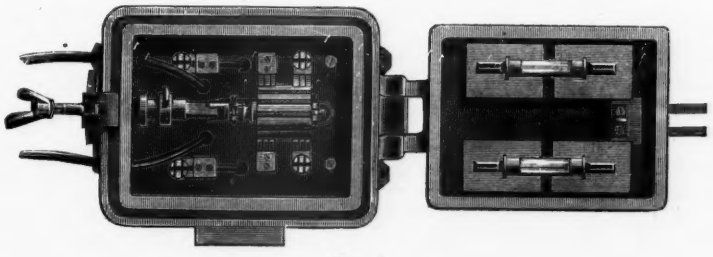


Fig. 2.

HINTS TO THE YOUNG ENGINEER.

In its "Answers to Correspondents'" column recently our New York contemporary, *Electricity*, gave the following excellent advice to a young man aged 20 years, a student in mechanical engineering, who was anxious to enter the electrical field. We consider the remarks worthy of reproduction. They should interest young men in this country who have leanings in the same direction as the young American student referred to :—

The demand for positions in electrical shops by young men who have had no technical training and even by those who have just graduated is so great that one considers himself extremely

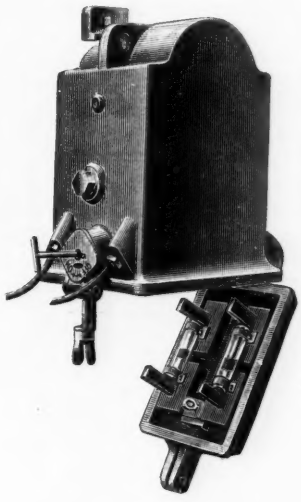


Fig. 1.

fortunate if he gets such a position without pay. Several of our larger electrical manufacturing concerns have established what they call "student classes," to which a limited number of young men are admitted each year or as vacancies occur. We understand that the demand for such positions largely exceeds the supply, and that there are always a number on the list awaiting the first vacancy. Such students, we believe, receive no salary, or at best but a nominal one, and those who have had some technical training are preferred to those who have not, for their progress is sure to be more rapid.

The young man, no matter how thorough his school training may have been, must realise that when he first enters a shop he is of little or no real value to his employer. He is, in a sense, in the way. Manufacturers know this, of course, and there are but two motives which can possibly actuate them when they take such men into their employment—the one is a kindly desire to help those who are anxious to help themselves, and the other is the expectation that by giving such help the novice may soon become of real use to them. Under neither of these conditions can large salaries be expected, and if our idea of the situation is correct, it shows how almost entirely the success of the novice must depend upon his own efforts after he has gotten the position.

As to the position which the young man should expect to get, he must expect to do anything, however menial or dirty, that offers and which is within his capabilities. If it is so simple a thing as stringing wires, he must have some one to show him how, and his readiness to learn the first job he is given will be taken as a gauge of his abilities. If he does not know the theory or mathematics of electricity, he will never learn it in the shop. He should have a few good books at his room, and at night, after supper, should study these books and try to find out the whys and wherefores of the things done during the preceding day. If he gets stalled, as he is frequently likely to do, there will certainly be some one

around the shop who will be able and willing to set him right the next day if he evinces an earnest desire to learn.

Even if one feels competent to do something better than the mere drudgery of shop work, it would be a misfortune for him to attempt it at first. We know of young men who were so thoroughly equipped technically at school that on the strength of their acquirements they were at once given positions too far advanced for them in practical work. They to-day regret it, and if they had their life over again would voluntarily start from the lowest round. They cannot do it now, for pride stands in the way, and they realise that their career must ever be incomplete, simply for the reason that the superstructure which they are now building with so much care is built without proper foundation.

ELECTRIC RAILWAY POWER STATIONS IN AMERICA AND THE ECONOMIC RESULTS OF THEIR OPERATION.*

By L. D. TANDY.

(*Concluded from page* 100.)

On referring to Table II. a percentage comparison of stations A, C and D will be found, showing the percentage of each item of expense to the total cost of the power. This comparison shows forcibly the relative merits of the direct

Table II.

		Station A.	Station C.	Station D.
Operation.	Coal	46· %	36·8 %	49· %
	Water	3·92	3·2	5·04
	Cylinder oil	2·19	1·15	1·144
	Engine	·437	1·575	·862
	Grease	·109	·147	...
	Waste	·175	·118	·1658
	Boilers	·153	·515	·116
	Engines and pumps	·262	·383	·199
	Miscellaneous	·109	·236	1·245
	Total	53·355	44·124	57·9
	Engineers, oilers, and wipers	14·65	21·64	15·65
	Firemen and water tenders	11·25	11·31	7·47
	Miscellaneous	6·39	2·245	1·89
	Total	32·25	35·2	25·
	Electrical supplies	·81	1·34	2·24
	Electrical labour	8·26	10·72	12·05
	Total	9·07	12·05	14·3
	Grand total for operation	94·6	91·25	97·4
Maintenance.	Buildings	·153	·074	...
	Boilers	·787	·942	·762
	Engines and pumps	...	·972	·315
	Coal pockets and sundries	...	·044	·034
	Total	·94	2·025	1·111
	Buildings	·262	·280	...
	Boilers	1·4	2·782	·397
	Engines and pumps	2·038	2·89	·563
	Coal pockets	...	·545	·083
	Total	3·7	6·49	1·04
	Electrical supplies	·284	·029	·445
	Electrical labour	·458	·118	·397
	Total	·765	·147	·844
	Grand total for maintenance	5·405	8·67	2·995

connected, belt driven, condensing and non-condensing stations. For the purpose of making the comparison, the coal used in station D has been computed at the same price as that at stations A and C, it being the same grade of coal, the difference in cost lying in transportation charges. The conditions under which the above stations are operating are about the same, the only difference being in size, A and C being the larger, which would naturally reflect to the disadvantage of station D. This is partly, if not wholly, offset by the fact that station D has a slightly larger average load, in comparison with its rated capacity, than stations A and C, more especially the latter.

Taking into consideration first the relative merits of the direct connected and belt driven stations, it will be found:

First. A difference in percentage of coal in favour of station C; also in water. This is due to the fact that the cost of coal does not decline in a direct ratio with the total cost, larger savings being made in other items.

Second. The item of cylinder oil shows also in favour of station C. Engine oil and grease show in favour of station A, due to a lesser number of bearings. Taking the item of lubrication as a whole, it is an offset.

Third. Material for the operation of boilers, engines, and pumps, and miscellaneous material will be found to be in favour of station A.

Fourth. Labour for operation of steam plant. The item of engineers, oilers, and wipers shows 6 per cent. in favour of station A, due to less oiling and attendance; firemen and water tenders constitute an offset. Miscellaneous labour shows 4 per cent. in favour of station C.

Fifth. Electrical material and labour for operation both show in favour of station A.

Table III.—Comparison in Cost per Kilowatt Hour.

		Station A.	Station C.	Station D.
Operation.	Material, Steam Dept.	$·003245	$·004000	$·004660
	Labour, „ „	·001964	·003184	·002014
	Total, Steam Dept.	$·005209	$·007184	$·006674
	Material, Elec. Dept.	$·000049	$·000121	$·000180
	Labour, „ „	·000504	·000970	·000970
	Total, Elec. Dept.	$·000553	$·001091	$·001150
	Grand Total for Operation	$·005762	$·008275	$·007824
Maintenance.	Material, Steam Dept.	$·000057	$·000185	$·000089
	Labour, „ „	·000225	·000588	·000084
	Total, Steam Dept.	$·000282	$·000773	$·000173
	Material, Elec. Dept.	$·000017	$·000003	$·000036
	Labour, „ „	·000028	·000010	·000032
	Total, Elec. Dept.	$·000047	$·000013	$·000069
	Grand Total for Maintenance	$·000329	$·000786	$·000241
		$·006091	$·009041	$·008065

* Coal computed same price as stations A and C.

Sixth. The grand total of operating expenses shows about 3 per cent. in favour of station C.

Seventh. Material for maintenance of building, boilers, engine and pumps, coal pockets, &c., shows about 3 per cent. in favour of station A.

Eighth. Labour for maintenance of building, boilers, engines and pumps, coal pockets, &c., shows about 5 per cent. in favour of station A.

Ninth. Electrical maintenance, labour and material shows about 5 per cent. in favour of station C.

On comparing station D with stations A and C, a loss will, of course, be found in coal and water, but a gain is shown both in engine and cylinder oil and grease, and besides a larger gain in labour of the steam department; a decided gain will also be found in maintenance.

The writer's purpose in making the above comparison is to show the *relation* which each item of expense bears to the whole, not the *percentage of economy*.

Taking the matter of economy into consideration, the figures for the various general items per kilowatt-hour will be found in Table III.

In the grand total for operation, a saving of 30 per cent. in station A over station C, and 26 per cent. over station D, will be found. In maintenance, a saving in station A over station C, amounting to 58 per cent., is shown, and an increase (or loss) in favour of station C amounting to 36 per

* *Street Railway Journal.*

cent., which station is also 24·6 per cent. less than station D. On total cost, station A is 30·8 per cent. less than station C.

Taking station D (a non-condensing belted station) in comparison with station C (a condensing belted station) it will be seen that in cost of operation, station D is running 5·5 per cent. less than station C; in maintenance 69 per cent. less than station C, and on the total cost station D is 10·8 per cent. less than station C. It must be remembered, in making this comparison, that station C is not carrying as heavy an average load, compared to its size, as either stations A or D, and station D is carrying a heavier average load than either stations A or C, but it is also a much smaller station. Some idea can be derived from the foregoing exhibits of the relative economies in the cost of producing power; also that the day of belt driven generators is past, as the economy of direct connected generators is self-evident from a careful study of their respective performance. But to get at the dollars and cents actually saved, it is necessary to take up the all-important item of fixed charges, and ascertain whether the increased cost of one type of station over another has resulted in saving enough to offset the increased fixed charges, owing to the greater initial investment. In some of our large stations I found compound condensing engines and water tube boilers operating at a pressure of 110 to 120 lbs. Wherein the economy lies in the use of water tube boilers, and condensing at this pressure, is far from being plain. The cost of operating a station of this character I have not given, owing to the poor showing which it makes.

Power can be (and is now being) produced, with coal at $1·60 per ton, for $31·61 per horse-power year of 365 days, with 20 hour days. The cost will range as high as $70, owing to conditions and price of coal, as there are some small, high speed, belted stations to-day whose power is costing them from $·013 to $·015 per kilowatt-hour.

OBSERVATIONS ON MAGNETISED WATCHES.*

BY WILLIAM T. LEWIS, Member of the Institute, President of the Horological Society of Philadelphia.

IN this age of electricity and electrically-propelled machinery, the wearers of watches are constantly coming in contact with sources of danger to the fine time-keeping qualities of their vest-pocket companions.

Non-magnetic watches are those in which the balance-wheel, hair-spring, roller-table, lever and 'scape-wheel are

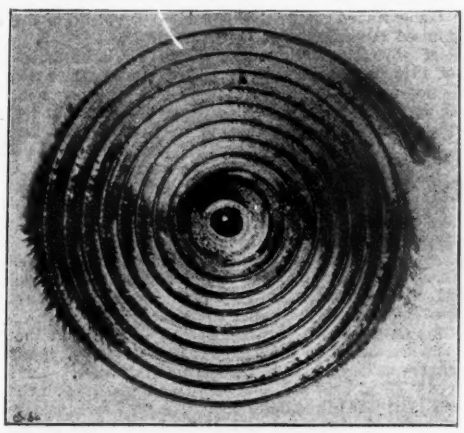


FIG. 1.

made of metals which are neither magnetic nor diamagnetic; and such watches have been brought to a high degree of perfection, some having been produced which have had nearly as close a rate as the best of those which are not non-magnetic. In addition to this, several varieties of anti-magnetic shields have been placed on the market, which are said to be more or less effectual in preventing magnetism in watches.

* *Franklin Institute Journal.* Read at the stated meeting of the Franklin Institute, November 18th, 1896.

However, it is of the ordinary watch (which is not non-magnetic) that I wish to speak to-night. In such a watch the hair-spring, roller-table, lever and 'scape-wheel are made of steel either wholly or in part. A watch of this kind will become magnetised by being brought into too close proximity to a powerful magnetic field, such as is developed in a dynamo or a motor; or by coming in contact with, or by being brought near to, an ordinary magnet; and there are also other sources of magnetic and electro-magnetic influence which will act injuriously upon a watch.

It will be seen that as all the steel parts of the watch become permanent magnets under the conditions mentioned, each steel part thus assumes definite polarity and tends to place itself in a north-and-south position like a compass. Moreover, each steel part attracts and is attracted by, and repels and is repelled by, every other steel part in the watch.

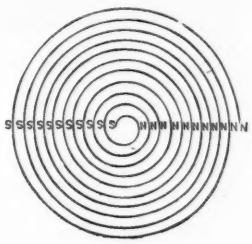


FIG. 2.

The influence of these magnets, one on the other, and the influence of the earth's magnetism on the several parts, seriously impede their freedom of motion, thereby affecting the rate of the watch, sometimes even causing it to stop.

A simple method to detect the presence of magnetism in a watch is to place a small compass (one with a very fine sensitive needle about 0·8 centimetres in length) directly over the balance-wheel and upon the "bridge" which supports it. If the needle oscillates it is evident that the watch is magnetised. However, this test is not conclusive, as the hair-spring may be magnetised, and, under certain conditions, the needle will not show it.

FIG. 3.

I am not aware that any one has yet called attention to the fact that the hair-spring or the main-spring of a magnetised watch contains "consequent magnetic poles," and I will endeavour to show that such is a fact, by means of the following experiments which I have made:

A hair-spring, which was placed in a powerful electro-magnetic field, was afterwards dipped in iron filings and photographed. The result is shown in fig. 1.

On testing its polarity (to do which it was necessary to straighten the hair-spring out into a long riband, similar to its condition before it was coiled into shape) it was found to contain numerous consequent poles, as shown in fig. 2.

In a watch the outer end of the hair-spring is stationary, while the inner end is fastened to a collet which vibrates

with the balance-wheel. As the balance-wheel makes approximately one and one-half revolutions at each vibration (*i.e.*, 270° on each side of the "dead centre"), it is evident that at the moment when a watch becomes magnetised, the hair-spring will probably be at some other position than that of rest.

Fig. 3 shows a hair-spring which was magnetised when the balance-wheel had arrived at the end of its arc of vibration, and photographed (having been dipped in iron filings) after it had returned to its position of rest. The

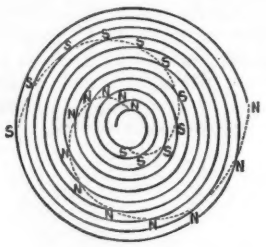


FIG. 4.

poles are not in the same straight line as in figs. 1 and 2, as is shown by the iron filings grouping themselves in a different manner.

The polarity was found, on testing, to be as shown in fig. 4, the dotted lines, passing through the poles, forming geometric curves.

Fig. 5 shows a form of demagnetiser in common use, which consists, essentially, of a helix, F, switch or key, C, the commutator, A, which serves the purpose of changing

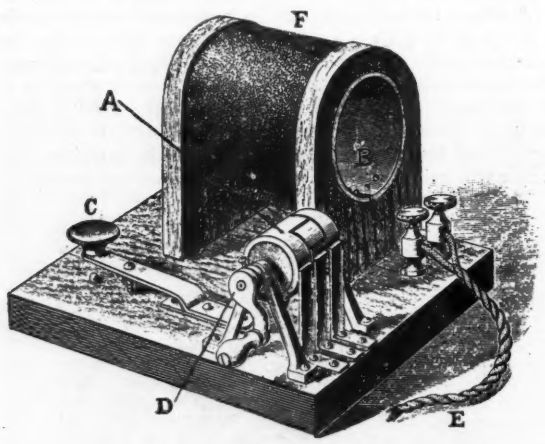


FIG. 5.

the polarity of the helix, and the flexible cord, E, to connect the machine with a battery or with an electric light circuit. If the current be alternating, the commutator can, of course, be dispensed with.

In operating with this machine the key is pressed down, and the commutator is turned by means of the crank, D, at a speed of about 150 revolutions per minute. The watch is then passed slowly through the helix, the speed of the crank being kept uniform in the meantime.

(*To be continued.*)

THE "KOSMO" CONCENTRIC WIRING.

THE general plan of this wiring is to lead cables from the main double pole cut-out to distributing centres on each floor of the building. These distributing centres are double pole switch and fuse boxes from which the section cables radiate. When the small branch conductors are jointed to the section cables a single pole switch and fuse, or a single pole fuse, is inserted upon the joint box and placed in the circuit of the "*outer*" *conductor* in the manner herein described. The conductors, having a mechanical protection of solid drawn lead tube, are laid like flexible gas pipes, and, excepting the larger sizes, the conductors can readily and safely be bent to the contour of the walls, mouldings, and angles of buildings. In practice it has been found that, where necessary, they can be perfectly secured to plaster work by means of bronzed metal saddles fixed by short round-headed screws inserted in the plaster work. This method of fixing the conductors greatly simplifies and cheapens the wiring of highly decorated apartments, and renders the fitting up possible without any serious defacement of walls or decorations. The lead encased conductors can, if desired, be coloured before being fixed in position, and may be run immediately beneath the plaster mould round the apartment, no "plugging" of walls being necessary when the plaster is of ordinary good quality, as the screws get a firm hold when carefully inserted. Upon wood work the ordinary brass saddle pins may be used, while upon unplastered walls the common gas pipe hooks will make good fastenings.

Concentric cables with both conductors insulated as heretofore made have the aggregate sectional areas of the "inner" and "outer" conductors equal; consequently, in the small sizes of cable used for internal wiring the individual sectional area of the "outer" strands of the conductors is too small to afford a practically sound jointing; they are also readily fractured.

The special feature of the smaller sizes of "Kosmo" concentric cables is that the aggregate sectional area of the insulated "outer" conductor is in every case more than twice the area of the "inner,"

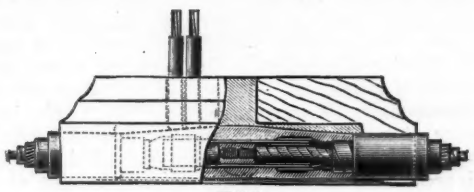


FIG. 1

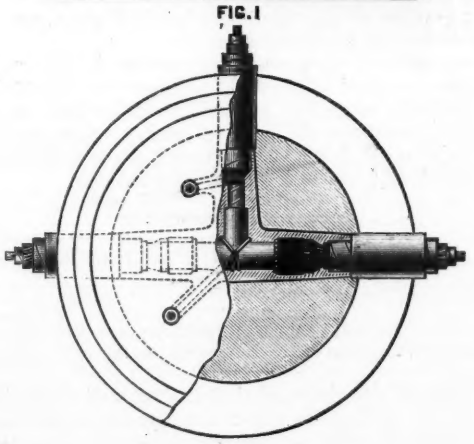


FIG. 2

the difficulties above set forth being thus satisfactorily surmounted. The conductors are of double tinned high conductivity copper, the "inner" being insulated with vulcanised India-rubber, and sheathed with the double tinned copper outer conductors, which are insulated with vulcanised rubber, and finally lead covered.

The chief objection to concentric wiring has hitherto been the absence of a simple and efficient method of jointing the conductors. This objection is entirely removed in the "Kosmo" system. The joints (see figs. 1 and 2) are made in a triple vice (figs. 3 and 4) fixed upon a platform which is screwed to a telescopic tubular pillar attached to a heavy cast-iron base; the joint table is thus adjustable to any convenient height. A floor base is also provided to carry the jointing table when joints are required to be made upon conductors running beneath the floors. If an ordinary T joint is to be made, the continuous cable is gripped by the two parallel vices, and the branch cable by the central vice.

A cutting tool, containing a series of cutters adjusted to the necessary depths, are used to cut the lead sheathing, outer insulation, outer conductors, and inner insulation of the cables, after which they are stripped ready for jointing with an ordinary jointer's knife. The "inners" are now jointed by wrapping and soldering in the usual manner, and the insulation is made good by a serving of pure rubber strip round the soldered joint to the required thickness.

A pair of "T" sockets are now taken and placed over the insulated inner joint just before described. The "T" sockets, and other sockets of different shape for various kinds of joints, are stamped out of high conductivity copper sheet, which is covered by a coating of tin to facilitate the adherence of solder. The split T is held firmly in position by a short length of tinned copper wire whipped round at the angles of the tee (see figs. 1 and 2), the ends of this wire being left long enough to come through a hole in the front of the joint box, and connect to one terminal of the switch fuse, which is mounted upon the face of the joint box as described hereafter.

The "outer" conductors of the continuous cable are now folded over the split "T," bound firmly round with a few turns of fine tinned iron wire, and soldered to the "T," as is also the copper wire previously mentioned. The "T" is now insulated with servings of pure rubber and black tape, in the same manner as an ordinary joint, and a short length of rubber tube insulates the lead passing through the joint box to the switch fuse.

The "outer" conductors of the branch cable are twisted together, properly insulated by taping, and likewise brought through a hole in front of the joint box, in order to be connected to the other terminal of the switch fuse. Whilst the three members of the T-joint are still held in position by the vices, a recessed cover forming the joint box is placed over the joint, and three members of the tee-joint fit in slotted grooves prepared in the rim of the box, the two outer wires before-mentioned being passed through holes in the front of the joint box.

A disc of stout oiled paper is then pressed upon the underside of the joint box, and a packing block is pushed in upon the vice-platform to hold the joint box and paper disc in place. The recess is then filled through a hole in the front of the box with an insulating and waterproof compound which quickly and firmly binds the joint and joint box together. The cable and joint box now being released from the vices, is ready for fixing in position.

Although, from the description, the jointing may appear to be rather a long operation, experience demonstrates that these joints are

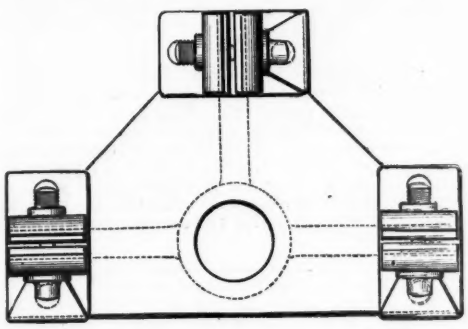


FIG. 3

easily made by any wireman of fair intelligence, and they can be completed in a reasonable time; they also safely stand a pressure of 2,000 volts alternating current.

The joint boxes for ordinary use are made of hard wood, polished, so as to form suitable bases for the fuses, or switch-fuses, which are fixed upon the points thereof; but for very damp and exposed situations, the boxes are to be made of metal, and the lead sheathing upon the conductors is soldered thereto.

Although any good make of fuse and switch may be used in conjunction with the "Kosmo" system; it is an advantage in many cases to have these accessories fixed upon the walls in the line of the conductors. In mills, warehouses, and stores this is particularly desirable, because it is less complicated and expensive than bringing the conductors down the wall to the switches, and because it removes all the electrical contacts from the reach of mischievous interference and damage. In hotels and high class buildings, an additional advantage is that all the conductors and fittings can be confined to the ceiling mouldings and dados, and the wall decoration is not damaged by un-

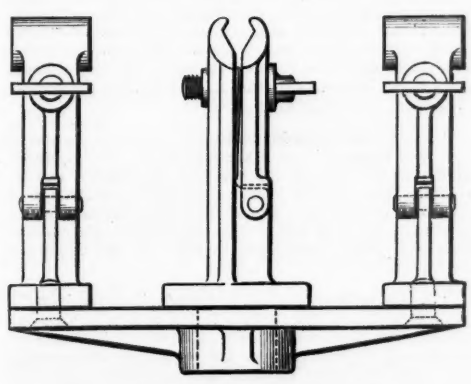


FIG. 4

sightly fixtures. To meet this desideratum, small quick-break switches have been designed, which are worked by a single cord hanging down the wall to within the reach of the operator, by means of which the lights are controlled. The cords and tassels are supplied in qualities and colours to harmonise with the surroundings.

Large double-pole section switches, and fuses in metal cases, are also designed upon this same principle. These larger switches are specially designed for the distribution to take the place of expensive switchboards, and they possess valuable features of utility and novelty well worth attention.

The switches are manufactured by the General Electric Company, and the "Kosmo cables," accessories, and tools, by the Telegraph Manufacturing Company, of Helsby, Manchester, and London.

SUPERHEATED STEAM ENGINE TRIALS.

AT the ordinary meeting of the Institution of Civil Engineers on Tuesday, January 12th, Mr. John Wolfe Barry, C.B., the President, in the chair, a paper was read on "Superheated Steam Engine Trials," by Prof. William Ripper, M.Inst.C.E.

The author pointed out that the use of superheated steam had been in abeyance for the past thirty years, during which time a continually increasing gain in steam engine efficiency had followed the development of the multiple expansion engine, and the increase of steam pressures. The limit having been now nearly reached in this direction, engineers were again reverting to superheating, from which a further considerable increase of efficiency might be looked for. Trials had been carried out on a 17 I.H.P. "Schmidt Motor," a single acting, simple, non-condensing engine, supplied with superheated steam from a Schimdt superheater, to determine the steam consumption of the engine working with various degrees of superheat, and at temperatures considerably beyond those usually employed; and also to find to what extent the dryness fraction of the steam, and the heat exchange between it and the cylinder walls, were affected by the superheat.

The heat expended in superheating reduced the amount of heat employed in evaporation of water; but the heat so diverted for the purpose of superheating was shown to be productive of a considerable gain in thermal efficiency. Thus an expenditure of 5, 10, and 15 per cent. of the furnace-heat to superheat gave a net gain of 12, 38, and 70 per cent. respectively of the work done for heat supplied.

When the load on the engine was fairly constant very little regulation of the superheat was necessary, and the temperature of the superheated steam in the coils remained remarkably steady. If the load on the engine was reduced, the temperature of the steam in the superheater immediately began to fall, though there was no appreciable change in the condition of the fire; on the other hand, if the load was increased, the temperature of superheat increased also. If superheated steam was desired at the engine, then the superheat being once taken up by the steam should have its high temperature preserved by all possible means till it reached the admission valve of the engine.

It was stated that no important gain could be theoretically expected from superheating, the actual gain in practice being due to the more or less complete removal of the loss by cylinder condensation. When steam was superheated it was in a more stable condition than without superheat, and if the steam contained sufficient excess heat, the steam in the cylinder could be rendered dry at cut-off and at release. This had been accomplished in certain of the trials described in the paper. Superheating thus removed the principal source of loss of heat in the cylinder, namely, water at release, and it reduced also the amount of the heat exchange between the steam and the cylinder walls to a minimum.

The effect of varying degrees of superheat upon the steam consumption per unit of power was illustrated by a large number of trials under varying conditions. Taking one example, it was shown that steam at 120 lbs. per square inch pressure superheated to 674° F. on entering engine, reduced the steam consumption from 38·5 lbs. without superheat, to 17·05 lbs. per I.H.P. per hour, the rate of decrease of steam consumption with increase of superheat being approximately uniform within certain limits.

It was pointed out from the indicator diagrams how rapidly the superheat disappeared on admission of the steam to the cylinder, and how few were the cases in which the steam in the cylinder was found to be superheated at cut-off, though admitted in a highly superheated condition. It appeared from these experiments that unless the degree of superheat of the steam entering the engine reached at least 200° F. above its normal temperature with a late cut-off, or a still higher degree of superheat for an earlier cut-off, the condition of the steam in the cylinder at cut-off was that of wet steam at the temperature of saturation.

In order that the steam in the cylinder might be superheated during expansion and dry at release, it was necessary that its temperature on entering the engine should be about 300° F. above the temperature normal to its pressure. When the steam was dry at release it was superheated at cut-off from 50° to 100° F., finally falling at end of about three expansions to the temperature of saturated steam. For a small increase in the number of expansions the temperature at cut-off rapidly fell to that of saturated steam.

The author considered superheating not as a means of obtaining a thermal efficiency in any way proportional to the temperatures used, but as a device for realising as far as possible the full thermal efficiency of saturated steam, by rendering the cylinder practically non-conducting. The practical difficulties supposed to be associated with the production and use of superheated steam had been satisfactorily overcome. Experience had shown that with ordinary care as to purity of feed-water, superheater tubes after long periods of severe work showed no signs of burning, scaling, or injury of any kind. With the greatly improved quality of lubricating oils no trouble need arise with the lubrication of superheated steam engines.

The best results could be obtained when the steam was supplied at about 650° F. at the engine. It was important to use good non-conducting material to maintain the high temperature of the steam in its passage to the engine. The best results in these trials had been obtained in association with a high range of pressure in one cylinder with a late cut-off. Any cause which tended to increase initial condensation in the cylinder with saturated steam tended also with superheated steam to absorb the superheat and to neutralise its useful effect in the cylinder. Superheated steam at high temperature might be safely and advantageously used in double-acting engines. Many such engines were now at work or in course of construction.

The point requiring chief consideration in the design of engines to

work with superheated steam was the steam-admission arrangements. The steam admission valve, being subjected to the maximum temperature, should be practically frictionless, so as to remove the necessity for its lubrication.

The paper was accompanied by an Appendix of Tables giving the results of a large number of trials, and accompanied by diagrams illustrating the effects of superheating on steam consumption, dryness fraction of steam during expansion, heat interchange between the steam and the cylinder walls, work done per lb. of steam, and thermal efficiency.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1897.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

683. "Improvements relating to electric traction on the surface contact system." J. McKenny, T. E. Doyle, and A. E. Poate. Dated January 11th.

749. "Improvements in and connected with apparatus for lighting and extinguishing gas jets by means of electricity." W. H. Gaitton and H. B. Sheridan. Dated January 11th.

846. "Improvements in automatic bye pass or governor for gas electrically controlled." L. B. Stevens. Dated January 12th.

851. "Improvements in brush holders for dynamo electric machines." P. R. Jackson & Co., Ltd., and J. S. Lewis. Dated January 12th.

859. "Process for the extraction of metallic alloys and pure metals by electric heat." Aschermann. Dated January 12th. (*Complete.*)

877. "An improved combined electric and hydraulic screw controlled elevator engine." P. R. J. Willis. (J. Parkinson, United States.) Dated January 12th.

902. "Automatic electric marine sounding apparatus." J. F. Babcock. Dated January 12th. (*Complete.*)

907. "An improved appliance to be used as an indicator signal or relay in connection with telephone switchboards and other analogous apparatus." P. Rabbidge. Dated January 12th.

916. "Improvements in and relating to electric incandescent gas globes and chimneys." J. Jackson. Dated January 13th.

946. "An improved combined electric and hydraulic elevator." P. R. J. Willis. (J. Parkinson, United States.) Dated January 13th.

964. "Improvements in reflectors for electric lamps and in supports for the same." F. A. Anderson and W. G. Waterman. Dated January 13th.

968. "Improved combined electric and hydraulic elevator." P. R. J. Willis. (J. Parkinson, United States.) Dated January 13th

995. "Improvements in galvanic batteries." W. S. Doe. Dated January 13th.

996. "Improvements in and relating to accumulator plates." W. Majert. Dated January 13th.

997. "Improvements in electric cables." S. P. Thompson. Dated January 14th.

1,016. "Improved method of staying filaments in incandescent lamps." H. E. Moul and the British Incandescent Electric Lamp Co., Ltd. Dated January 14th.

1,026. "Improvements in apparatus for the electro-deposition of metals. J. E. Hartley. (Partly communicated by F. W. Zingsem, United States). Dated January 14th.

1,086. "An improved governing appliance for electrical machines, applicable also for other purposes." J. H. McLean. Dated January 15th.

1,087. "Improvements in pipes and conduits for electric cable mains, and in jointing the same." N. Simmons. Dated January 15th.

1,099. "Improvements in and relating to accumulators or storage batteries." W. Rowbotham. Dated January 15th.

1,110. "Improvements in regulating and controlling the resistance of electric currents." R. H. Barnett. Dated January 15th.

1,143. "Depolarising material for galvanic elements." F. Mayer. Dated January 15th.

1,150. "Improvements in portable electric railways with overhead conductors. A. Koppel. Dated January 15th.

1,158. "An improved electric dynamo-motor." E. K. Scott and A. G. New. Dated January 15th. (*Complete.*)

1,159. "An electrically driven surfacing lathe." E. K. Scott and A. G. New. Dated January 15th.

1,203. "An improved secondary battery plate." H. W. Handcock and A. H. Dykes. Dated January 16th.

1,204. "An improved method of preparing positive plates for secondary batteries. H. W. Handcock and A. H. Dykes. Dated January 16th.

1,231. "Universally adjustable reflector or screen for electric glow lamps." P. De Kilduchevsky. Dated January 16th.

1,249. "Improvements in electrical switches." G. W. De Tunzelmann. Dated January 16th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free,* 8½*d.* (*in stamps*).]

1895.

16,569. "Improvements in the manufacture of electrodes for voltaic batteries." L. Epstein. Dated September 4th, 1895. Relates to electrodes, and chiefly to those in plate form, for secondary batteries. Plates of lead have their surfaces rendered porous in any known manner, they are then treated with a mixture of caustic alkali and any lead oxides and then dried. The plates are all preferably first converted into negative electrodes although they may be directly converted into positive electrodes after neutralising the alkali by treating them with acid and drying them several times in succession. Claims.

1896.

2,501. "An improved system for conveying and furnishing electricity to railway cars and devices used in connection therewith." A. S. Krotz, W. P. Allen, and O. S. Kelley. Dated February 4th, 1896. Relates to a method of making connection between electric street cars and conduit conductors. The conductors are contained in flexible casings made up of sections and arranged in suitable yokes forming the basis of the conduit. Each section has insulated U-shaped pieces normally out of contact. Contact is formed by the moving vehicle through the slotted portion of the yoke pressing upon the flexible casing and thus bringing the two U-shaped contact pieces into contact. Several modifications are mentioned. 9 Claims.

3,375. "Improvements in electrical contact devices for clocks and the like." T. S. Smith and G. C. Walker. Dated March 23rd, 1896. Relates to an electrical contact device for attachment to an existing timepiece with a fixed or rotatable glass disc. A spring is so arranged that contact will be made with the clock hand and broken before the hand has actually released such spring. An arrangement for producing a double alarm on an electric bell is also described. 3 claims.

5,171. "Improvements in lifting and lowering gear for electric arc lamps, electroliers, and the like." B. R. Baker. Dated March 7th, 1896. Relates to a gear for lifting and lowering an arc lamp consisting of a rotary grooved drum mounted between two fixed end discs carried in a frame, the lamp being suspended from an independent cord passing over the drums and pulleys. The lamp conductors are carried by the drum and connected through travelling rubbing contacts to the fixed line wires so that no weight or strain comes upon them. 4 Claims.

5,191. "Improvements in or relating to the conduits and collectors for electric railways." A. Petzenburger. Dated March 7th, 1896. Refers to an arrangement whereby one conduit can be used by two cars. The conduit containing the conductors is placed between the two inner rails. The contact piece enters in by the side of the conduit. Flaps of leather are arranged on the edges of the conduit cover to prevent mud from getting in to the conductors. 2 claims.

6,625. "A new or improved holder for telephone receivers." A. J. Fippard. Dated March 26th, 1896. Refers to a telephone receiver holder which is pivoted to the telephone base on its pivot so as to bring the diaphragm of the receiver near the ear and simultaneously close the bell circuit, but when required for use can be moved by the hand so as to break the bell circuit and close the operating circuit. 4 claims.

7,781. "Improvements in electric current transformers and method of cooling the same." J. Devonshire. (W. S. Moody, United States.) Dated April 14th, 1896. Relates to a method of cooling transformers by forcing oil up from the base of the transformer and allowing it to flow down the outside, thus allowing the oil which is heated in its path through the coils to cool in flowing down. 22 claims.

7,885. "Improved compound mould for forming incandescent electric lamp bases." J. Devonshire. (J. Henny and A. Pederquist, United States.) Dated April 14th, 1896. Relates to an improved mould for forming incandescent electric lamp bases and obviates the weighing of the plastic porcelain. By means of a suitable die the mass is compressed and the grooves are formed at the same time. 6 claims.